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COLUMBIA RIVER BASIN FISH CONTAMINANT SURVEY

VOLUME I
Appendix N

Estimated Cancer Risks by Study Site

July 2002

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N.1 Cancer Risk Comparisons

Cancer risks were estimated for fish collected in the Columbia River Basin as described in Section 6. Graphical representations of the data are presented in this section to show risk

estimates for multiple species, sample types, and sites. Total cancer risk at or above 1 X 10^{-6} are focused upon in the discussion in this Appendix.

N.1.2 Carcinogenic Risk Estimates

Upper bound total cancer risk estimates are presented graphically across a range of consumption rates from 0.6 g/day to 540 g/day for 30- and 70-year exposure durations. Each graph represents only one sampling site. Assuming a typical meal size of 8 ounces, 0.6 g/day corresponds to a consumption rate of one meal per year. The upper value, 540 g/day, corresponds to 900 meals per year, the maximum suggested fish consumption rate for tribal subsistence fishers within the Columbia River basin (Harris and Harper 1997). This range of consumption rates allows the reader to identify cancer risks associated with personal consumption patterns. Four drop lines are included in the plots to guide the reader in finding the cancer risk estimates corresponding to the consumption rates used in this report. The consumption rate of 7.5 g/day (12 meals/yr) corresponds to an adult in the general public with an average fish consumption rate, 63.2 g/day (103 meals/yr) corresponds to an adult in the CRITFC 's member tribal population with an average fish consumption rate, 142.4 g/day (232 meals/yr) corresponds to an adult in the general public with a high fish consumption rate, and 389 g/day (634 meals/yr) corresponds to an adult in the CRITFC 's member tribal population with a high fish consumption rate.

N.3 Cancer Risk Estimates by Site

N.3.1 Columbia River

Seven sites were sampled in the Columbia River, Sites 3, 6, 7, 8, 9L, 9U, and 14. At two sites in the Columbia River, Site 8 and Site 9U, more than one species with the same tissue type were collected, allowing for comparison of estimated cancer risk among these species.

Site 3 is located between the mouth of the Columbia River and Bonneville Dam. One species and sample type was collected at this site, whole-body samples of eulachon. Estimated cancer risk estimates were at or above $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration (Figure 6-21).

Site 6 is located between the Bonneville Dam and the Dalles Dam. One species and sample type was collected at this site, fillet samples of white sturgeon. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations (Figure 6-22).

Site 7 is located between the Dalles Dam and the John Day Dam. Fillet samples of white sturgeon and whole-body samples of walleye were collected at this site. Cancer risk estimates for both of the fillet and whole-body samples at Site 7 exceeded $1x10^{-6}$ at 30- and 70-year exposure durations (Figures 6-23 and 6-24).

Site 8 is located between the John Day Dam and the McNary Dam. Fillet samples of three species were collected at this site, fall chinook salmon, steelhead, and white sturgeon. Cancer risk estimates for fillet samples exceeded $1x10^{-6}$ for all three species at a 70-year exposure duration. At a 30-year exposure duration, cancer risk estimates exceeded $1x10^{-6}$ except for fall chinook salmon and steelhead at low consumption rates. The highest cancer risk estimates in fillet samples occurred in white sturgeon followed, in decreasing order, by fall chinook salmon and steelhead (Figure 6-25). Whole-body samples of four species were collected at this site, fall chinook salmon, largescale sucker, steelhead, and white sturgeon. Cancer risk estimates for whole-body samples exceeded $1x10^{-6}$ at a 70-year exposure duration. At a 30-year exposure duration, cancer risk estimates in whole-body samples exceeded $1x10^{-6}$ except for fall chinook salmon and steelhead at low consumption rates. The highest cancer risk estimates in whole-body samples occurred in white sturgeon, followed, in decreasing order, by largescale sucker, fall chinook salmon, and steelhead (Figure 6-26).

Site 9L is located in the Columbia River below the Snake River. One species was collected at this site, white sturgeon. Cancer risk estimates for fillet and whole-body samples at Site 9L exceeded $1x10^{-6}$ at 30- and 70-year exposure durations. Cancer risk estimates were slightly higher in fillet samples than in whole-body samples (Figure 6-27).

Site 9U is located in the Upper Columbia River above the Snake River. Three species were collected at this site, largescale sucker, mountain whitefish, and white sturgeon. Cancer risk estimates for fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations. Mountain whitefish had the highest cancer risk estimates followed, in decreasing order, by white sturgeon, and largescale sucker (Figures 6-28 and 6-29).

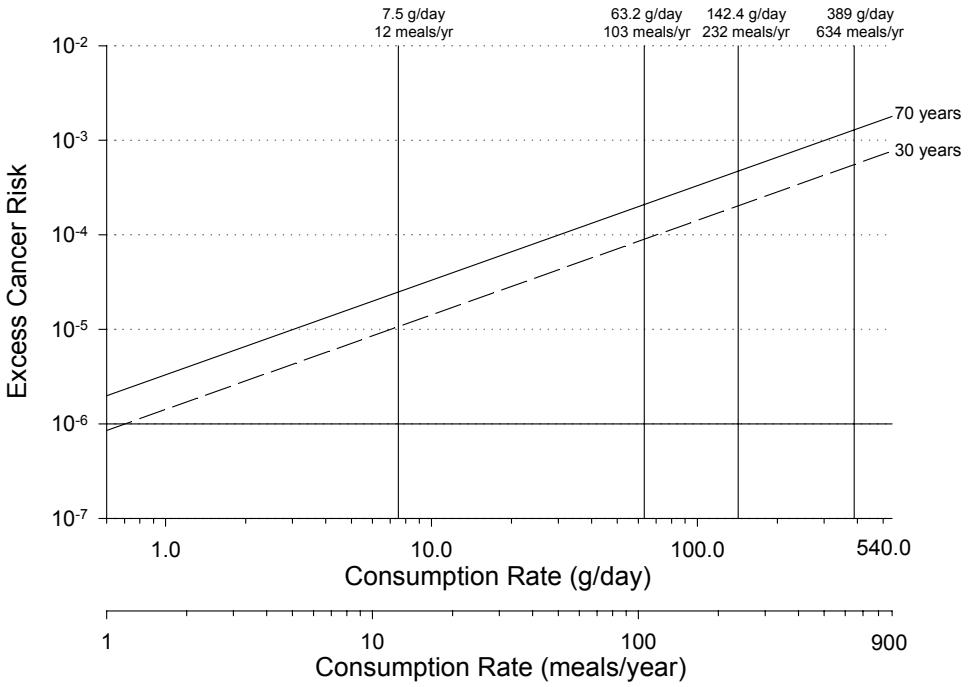


Figure 6-21. Excess cancer risk estimates for whole body samples of eulachon collected at Site 3, Columbia River

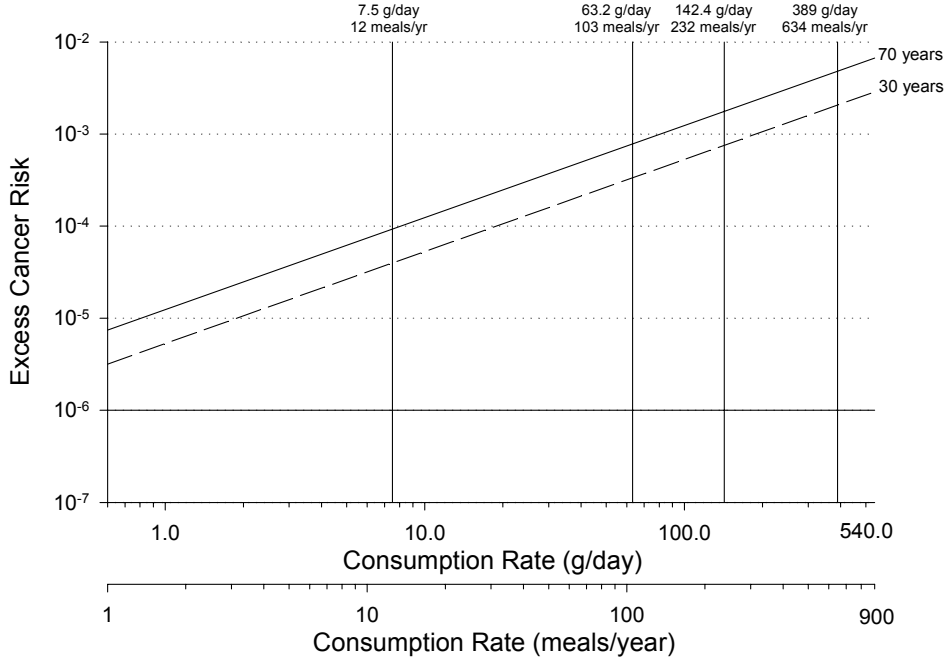


Figure 6-22. Excess cancer risk estimates for fillet samples of white sturgeon collected at Site 6, Columbia River

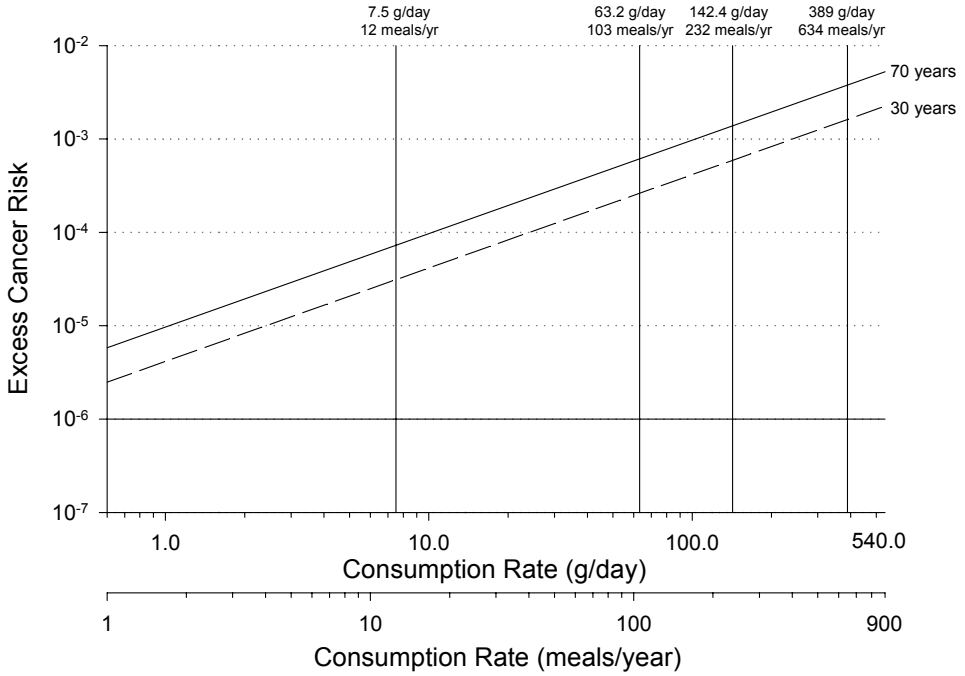


Figure 6-23. Excess cancer risk estimates for fillet samples of white sturgeon collected at Site 7, Columbia River

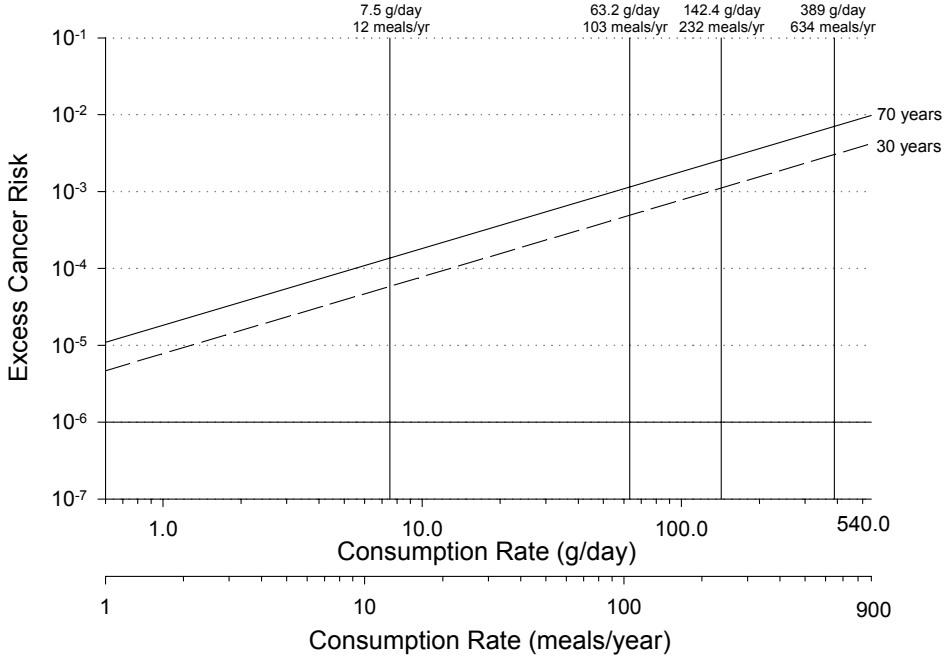


Figure 6-24. Excess cancer risk estimates for whole body samples of walleye collected at Site 7, Columbia River

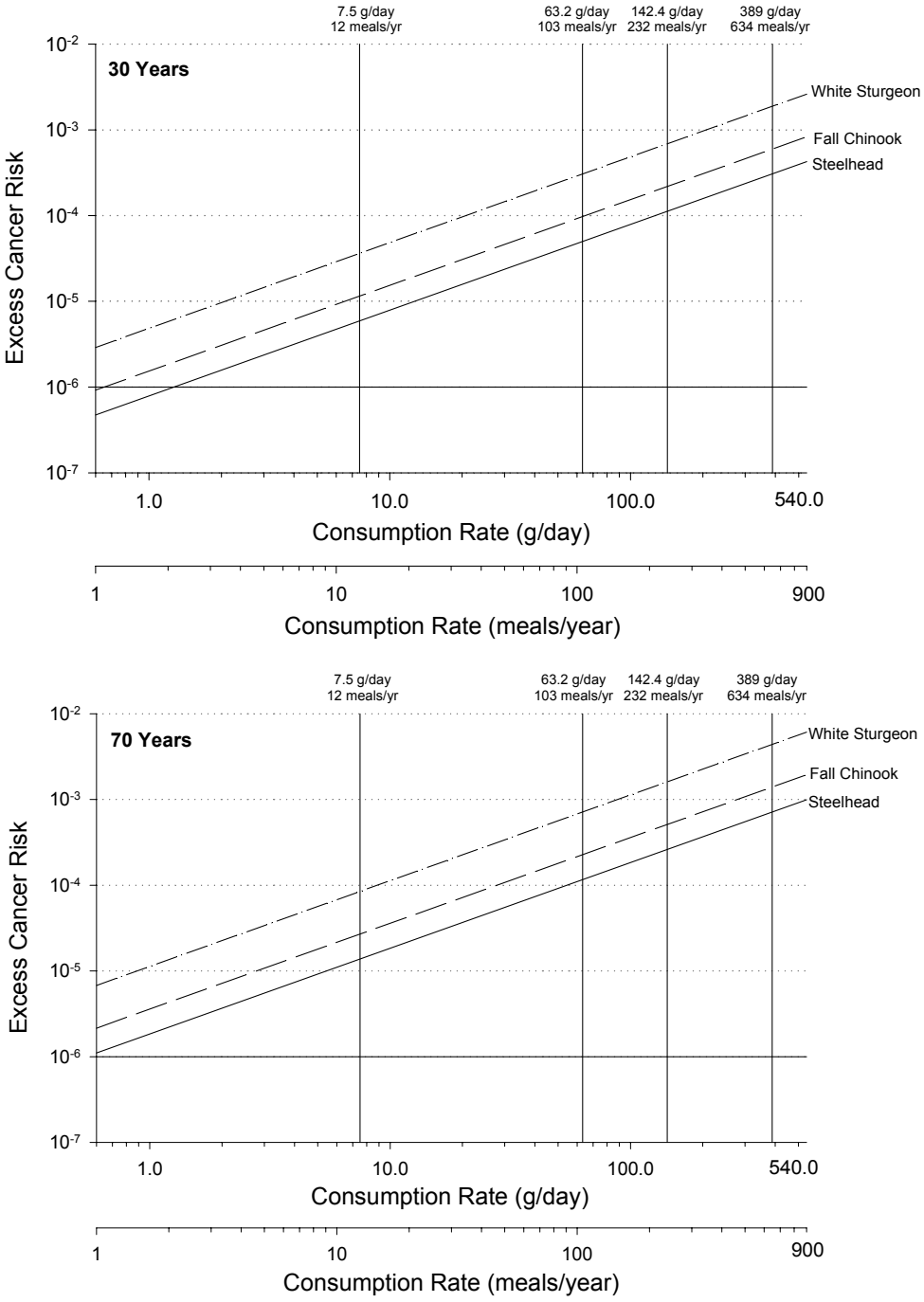


Figure 6-25. Excess cancer risk estimates for fillet samples of fish species collected at Site 8, Columbia River

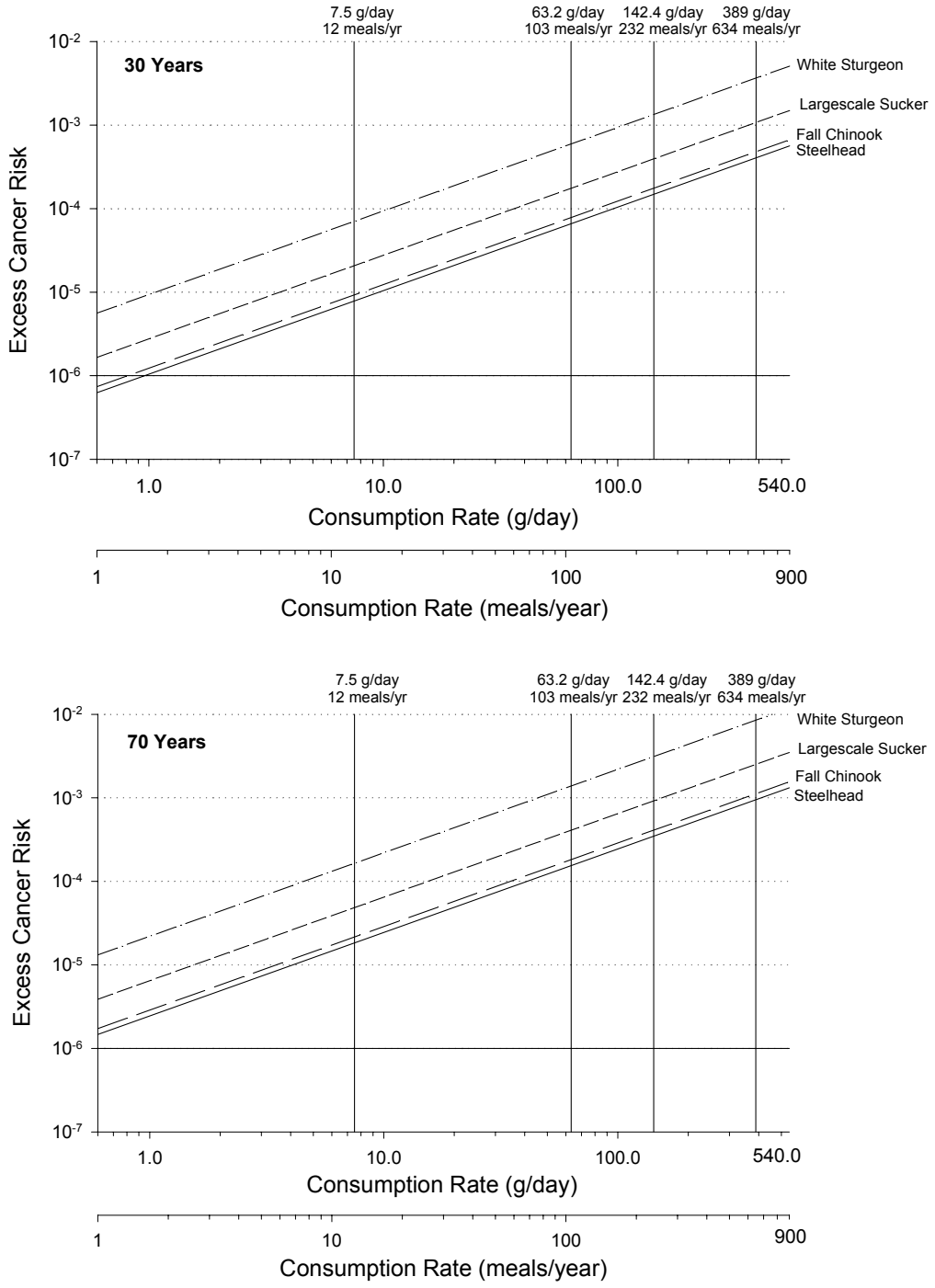
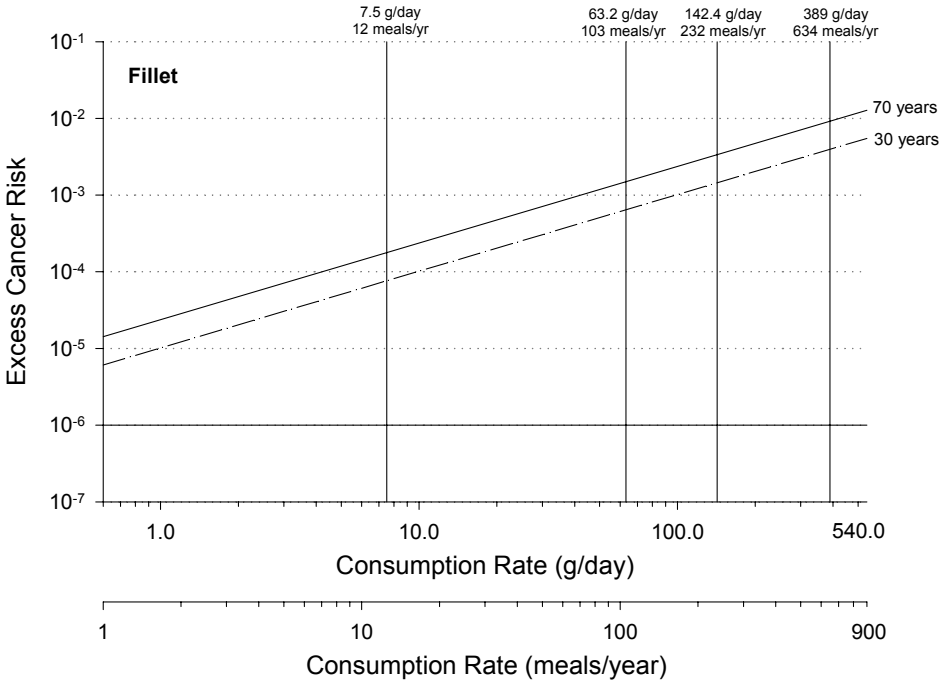


Figure 6-26. Excess cancer risk estimates for whole body samples of fish species collected at Site 8, Columbia River



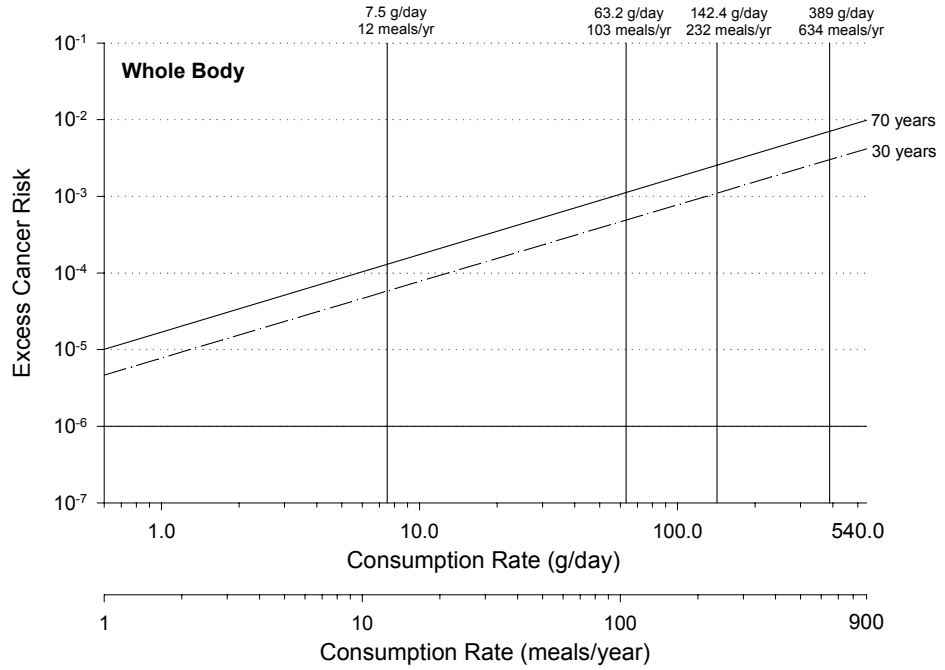


Figure 6-27. Excess cancer risk estimates for samples of white sturgeon collected at Site 9L, Columbia River

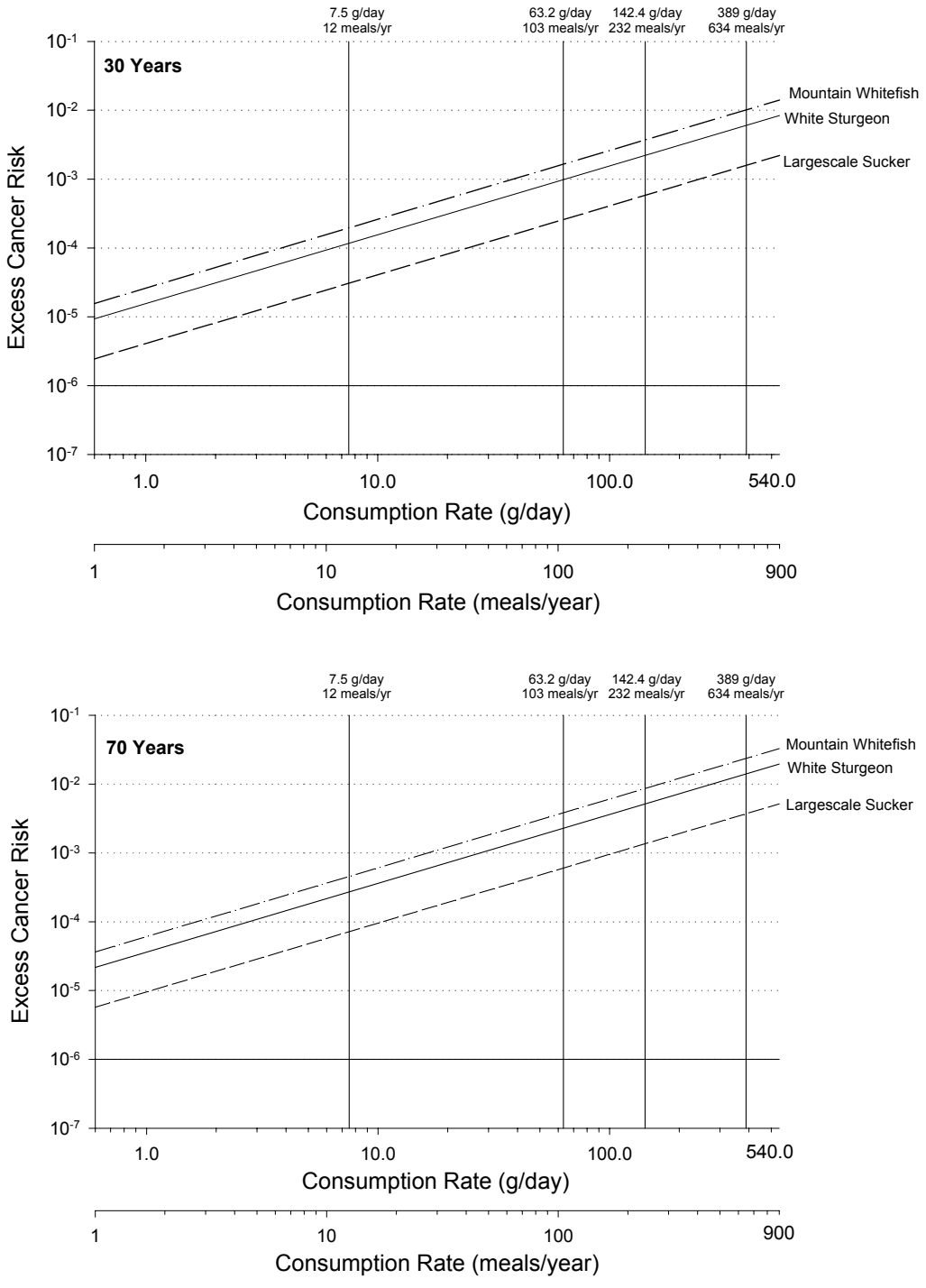


Figure 6-28. Excess cancer risk estimates for fillet samples of fish species collected at Site 9U, Columbia River

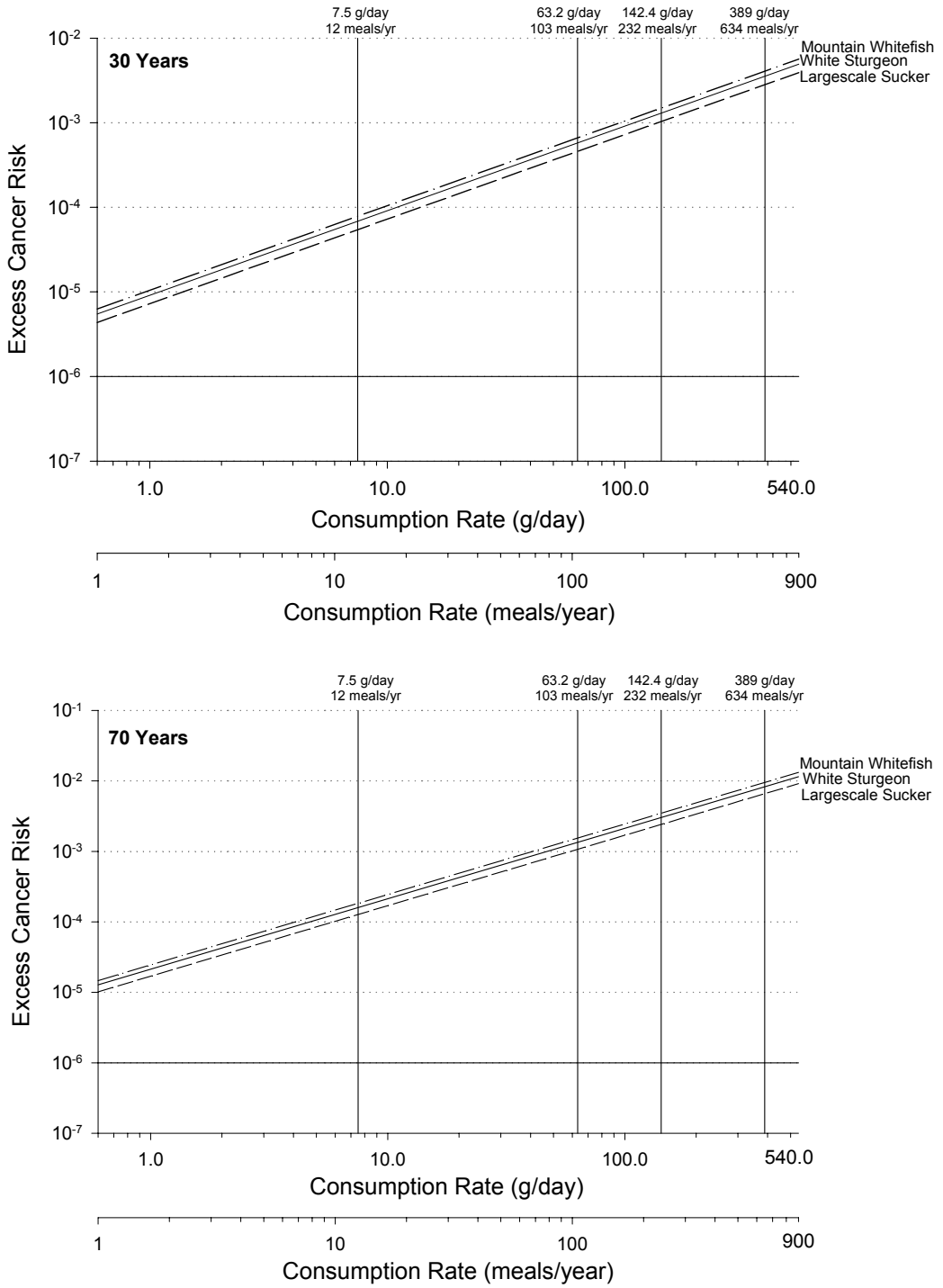


Figure 6-29. Excess cancer risk estimates for whole body samples of fish species collected at Site 9U, Columbia River

Site 14 is located in the Upper Columbia River above the Snake River. One species was collected at this site, fall chinook salmon. Cancer risk estimates for fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations (Figure 6-30).

N.3.2 Willamette River

One sampling site was located in the Willamette River, site 21. Two species were collected at this site, Pacific lamprey and spring chinook salmon. Cancer risk estimates for fillet samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for spring chinook salmon at very low consumption rates with a 30-year exposure duration. The highest cancer risk estimates occurred for Pacific lamprey followed by spring chinook salmon (Figure 6-31 and 6-32). The highest cancer risk estimates occurred for Pacific lamprey followed by spring chinook salmon .

N.3.3 Wind River

One sampling site was located in the Wind River, Site 63. One species was collected at this site, spring chinook salmon. Cancer risk estimates for both fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for the lowest consumption rates with a 30-year exposure duration (Figure 6-33).

N.3.4 Little White Salmon River

One sampling site was located in the Little White Salmon River, Site 62. One species was collected at this site, spring chinook salmon. Cancer risk estimates for both fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration (Figure 6-34).

N.3.5 Hood River

One sampling site was located in the Hood River. One species was collected at this site, steelhead. Cancer risk estimates for both fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations. Cancer risk estimates were slightly higher in fillet samples than in whole-body samples (Figure 6-35).

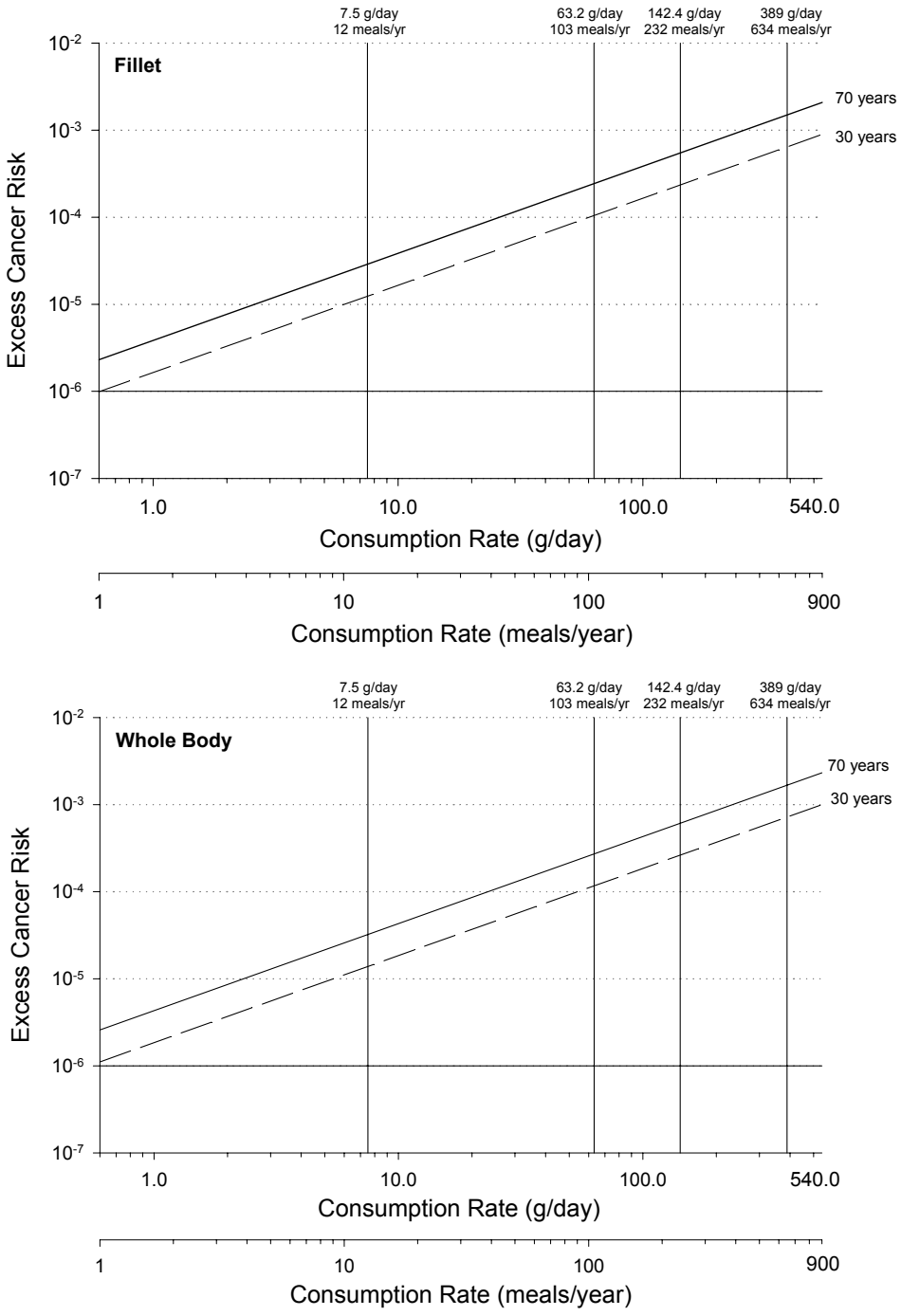
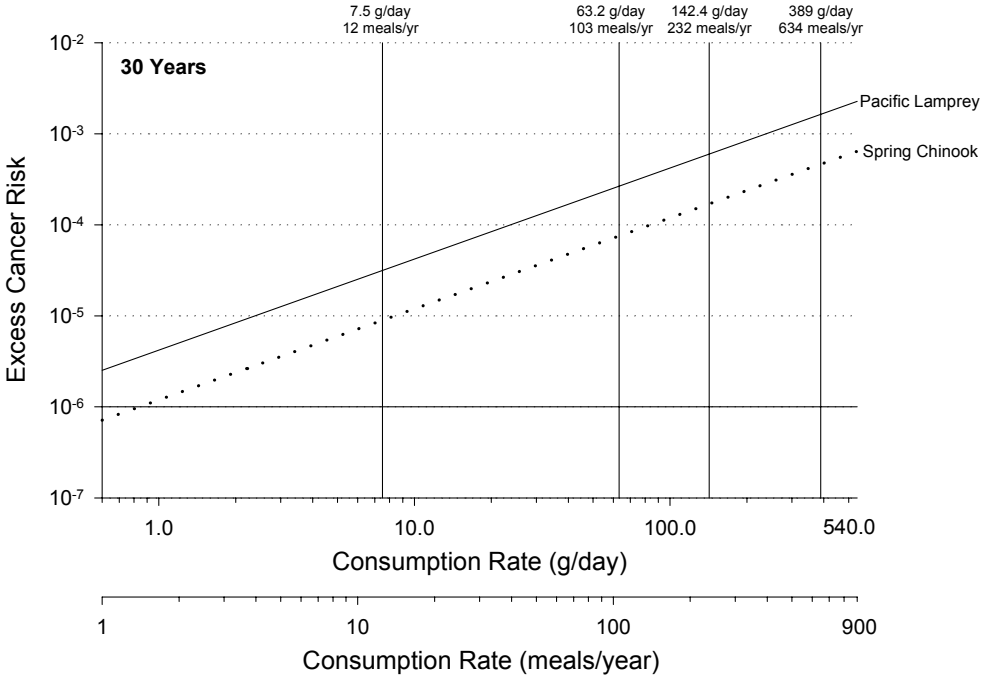


Figure 6-30. Excess cancer risk estimates for samples of fall chinook collected at Site 14, Columbia River



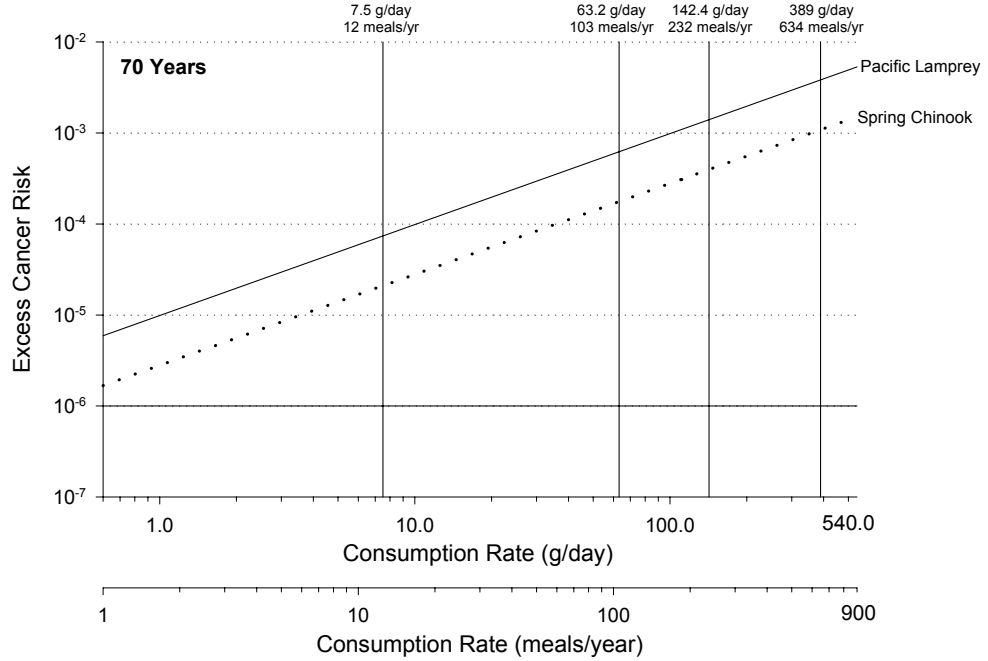


Figure 6-31. Excess cancer risk estimates for fillet samples of fish species collected at Site 21, Willamette River

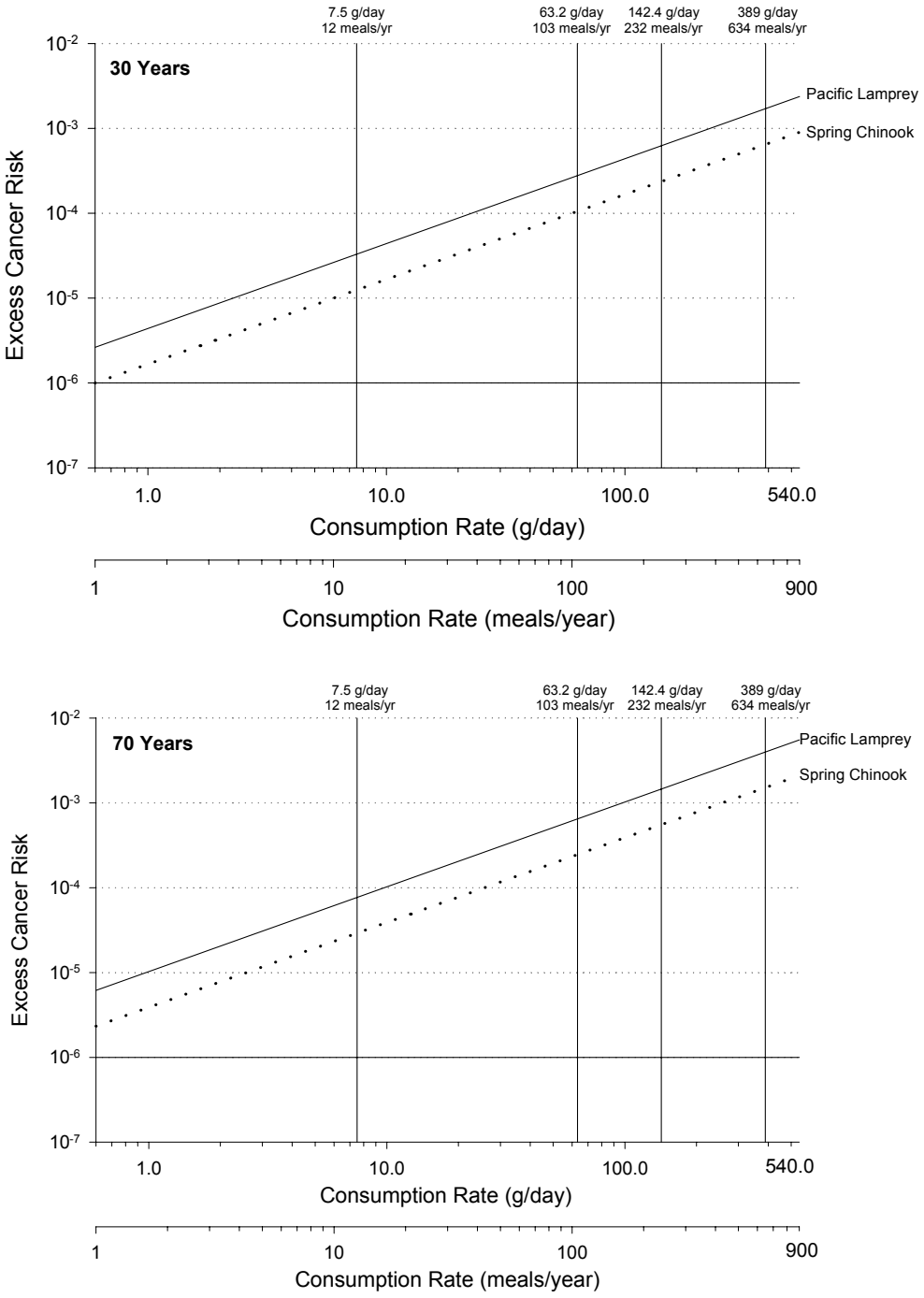


Figure 6-32. Excess cancer risk estimates for whole body samples of fish species collected at Site 21, Willamette River

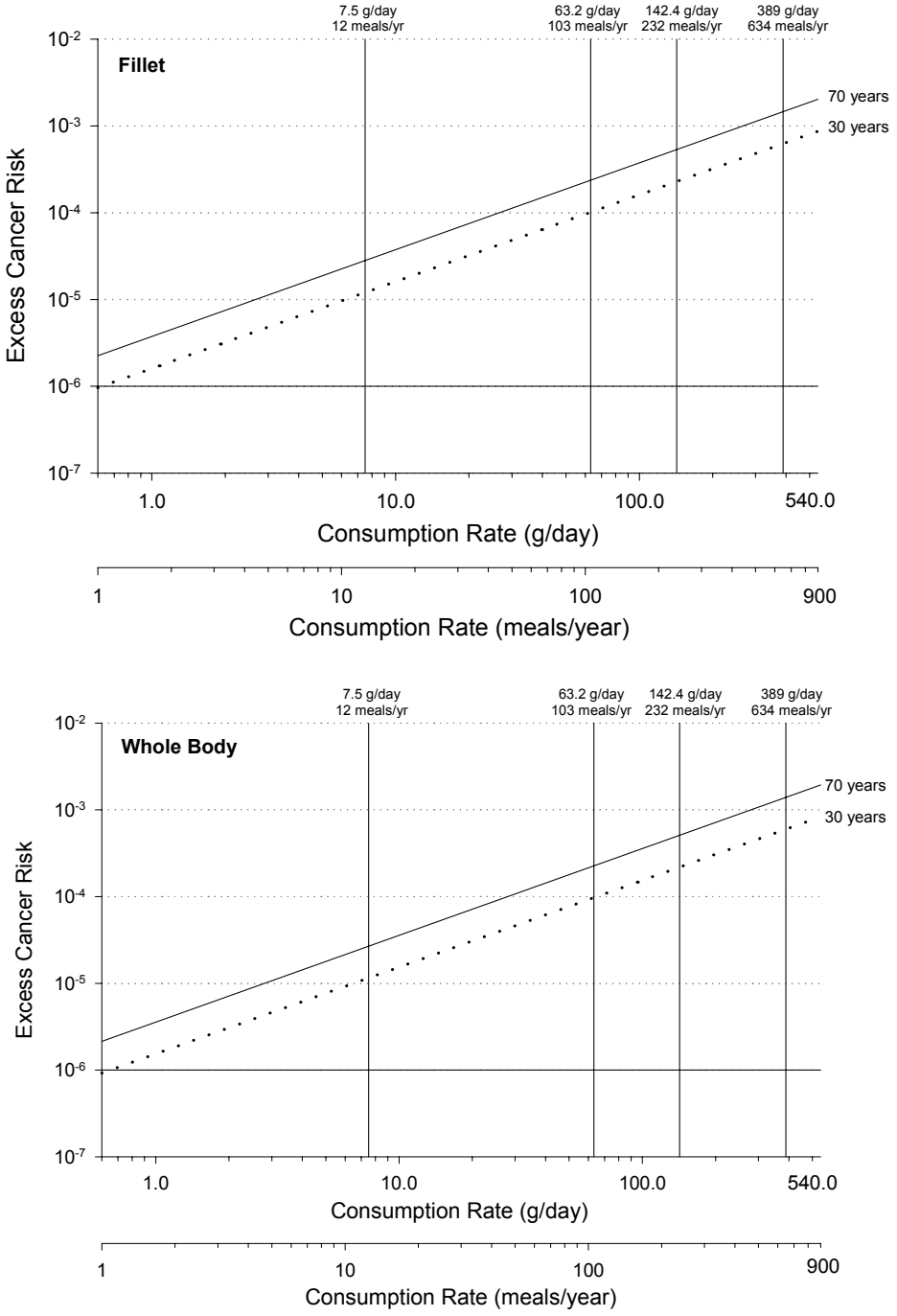


Figure 6-33. Excess cancer risk estimates for samples of spring chinook collected at Site 63, Wind River

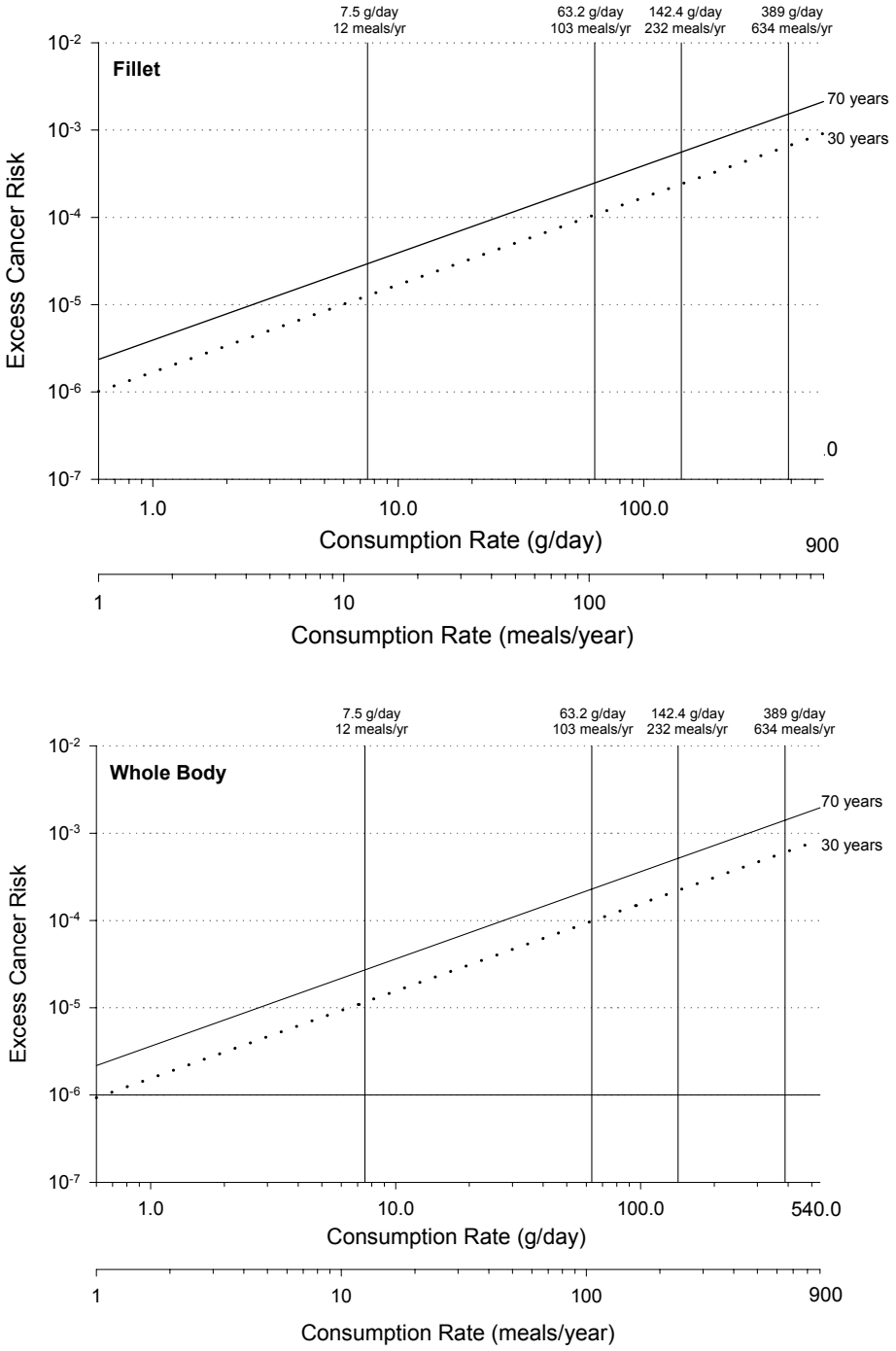


Figure 6-34. Excess cancer risk estimates for samples of spring chinook collected at Site 62, Little White Salmon River

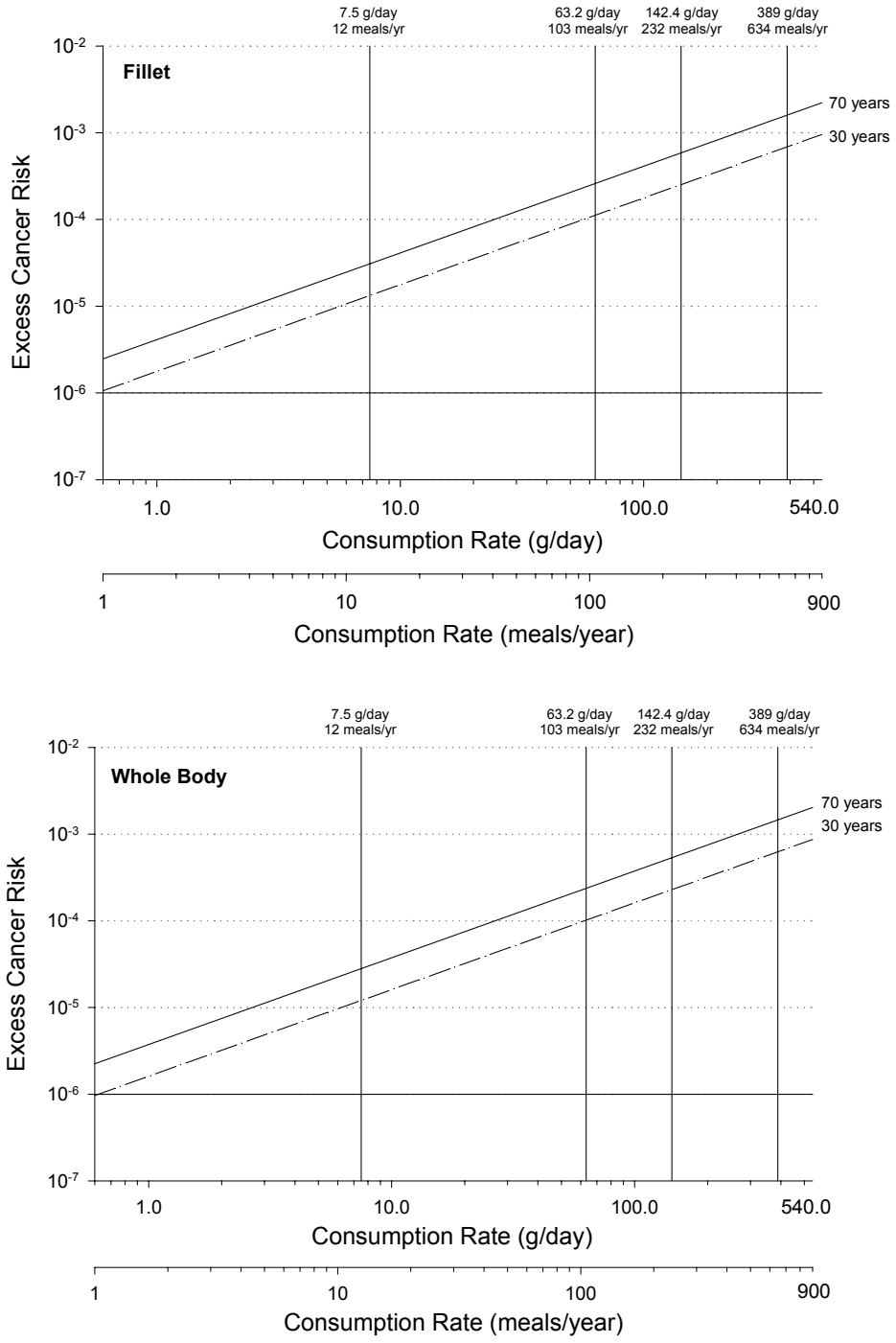


Figure 6-35. Excess cancer risk estimates for samples of steelhead collected at Site 25, Hood River

N.3.6 Klickitat River

One sampling site was located in the Klickitat River, site 56. Three species were collected at this site for fillet samples, fall chinook salmon, spring chinook salmon, and steelhead. Cancer risk estimates for fillet samples exceeded $1x10^{-6}$ at 70-year exposure durations; $1x10^{-6}$ was exceeded at 30 years, except for lowest consumption rates. The highest cancer risk estimates occurred for steelhead followed, in decreasing order, by spring chinook salmon and fall chinook salmon (Figure 6-36). Four species were collected at this site for whole-body samples, fall chinook salmon, rainbow trout, spring chinook salmon, and steelhead. Cancer risk estimates for whole-body samples exceeded $1x10^{-6}$ at 70-year exposure durations; $1x10^{-6}$ was exceeded at 30 years, except for lowest consumption rates. The highest cancer risk estimates occurred for spring chinook salmon followed, in decreasing order, by steelhead, fall chinook salmon, and rainbow trout (Figure 6-37).

N.3.7 Fifteen Mile Creek

One sampling site was located in Fifteen Mile Creek, site 24. One species and sample type was collected at this site, whole-body samples of Pacific lamprey. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations (Figure 6-38).

N.3.8 Deschutes River

One sampling site was located in the Deschutes River, site 98. Three species were collected at this site, largescale sucker, mountain whitefish, and rainbow trout. Cancer risk estimates in fillet samples exceeded $1x10^{-6}$ at a 70-year exposure duration. At a 30-year exposure duration, cancer risk estimates exceeded $1x10^{-6}$ except in rainbow trout and largescale sucker at low consumption rates. The highest cancer risks estimated in fillet samples occurred for mountain whitefish followed, in decreasing order, by rainbow trout, and largescale sucker (Figure 6-39). Cancer risk estimates in whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates at a 30-year exposure duration in rainbow trout. The highest cancer risk estimates in whole-body samples occurred for mountain whitefish followed, in decreasing order, by largescale sucker and rainbow trout (Figure 6-40).

N.3.9 Umatilla River

Two sampling sites were located in the Umatilla River, Sites 30 and 101. Five species were collected at Site 30, coho salmon, fall chinook salmon, largescale sucker, spring chinook salmon

and walleye. Cancer risk estimates in fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates at a 30-year exposure duration. The highest cancer risk estimates in fillet samples occurred for spring chinook salmon followed, in decreasing order, by coho salmon, largescale sucker, walleye, and fall chinook salmon (Figure 6-41). The highest cancer risk estimates in whole-body samples occurred for spring chinook salmon followed, in decreasing order, by fall chinook salmon, coho salmon, walleye, and largescale sucker (Figure 6-42).

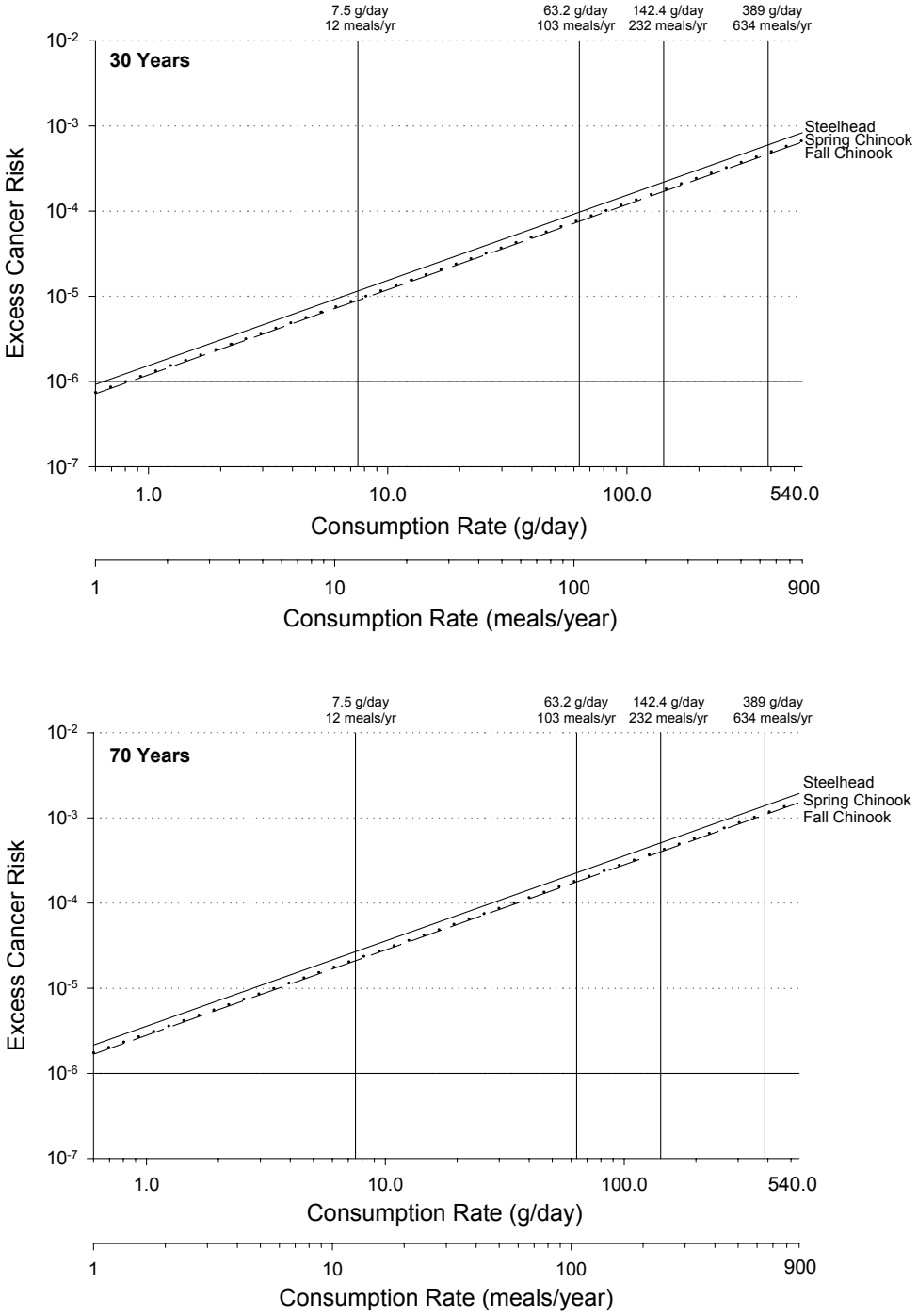


Figure 6-36. Excess cancer risk estimates for fillet samples of fish species collected at Site 56, Klickitat River

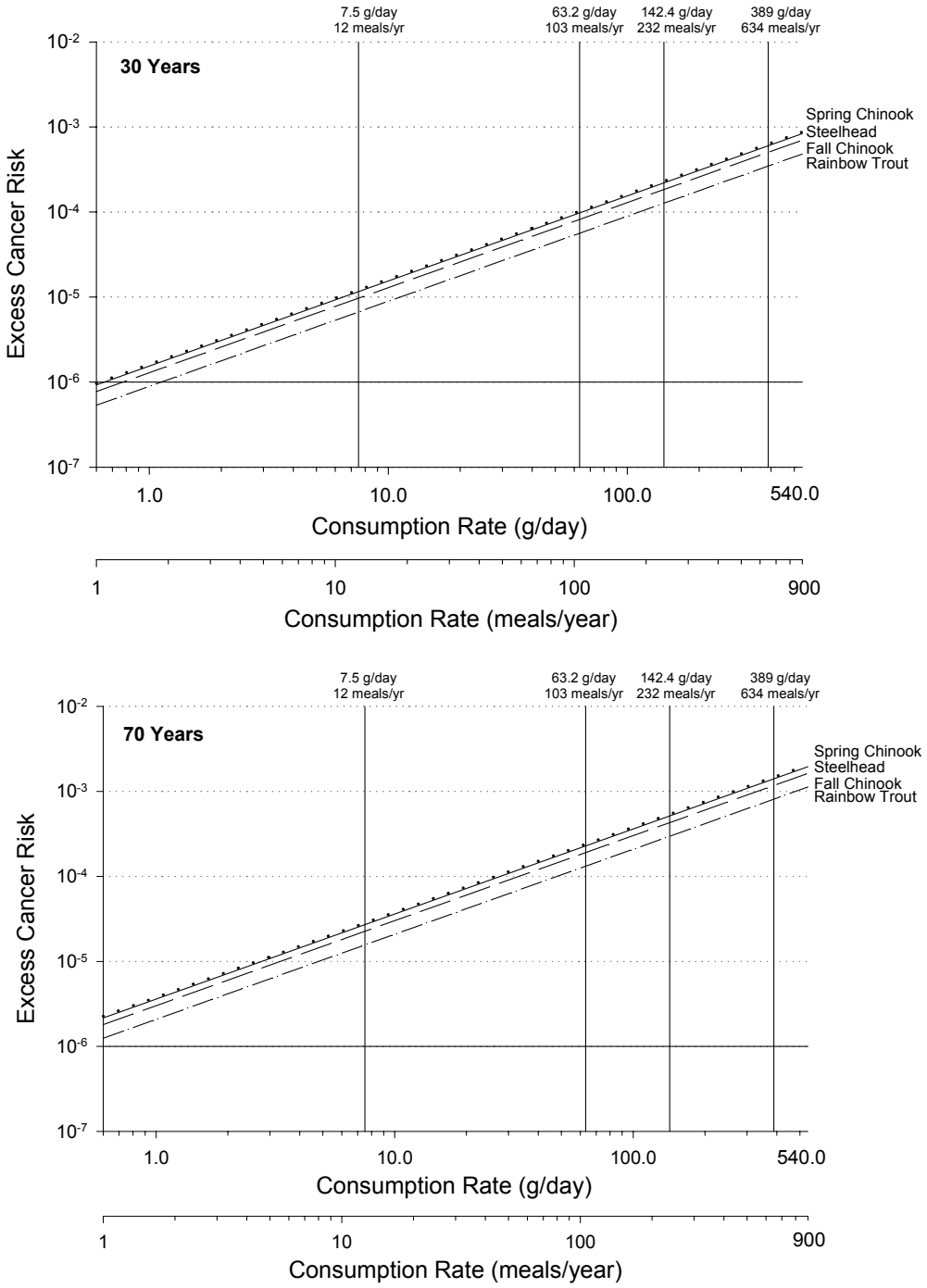


Figure 6-37. Excess cancer risk estimates for whole body samples of fish species collected at Site 56, Klickitat River

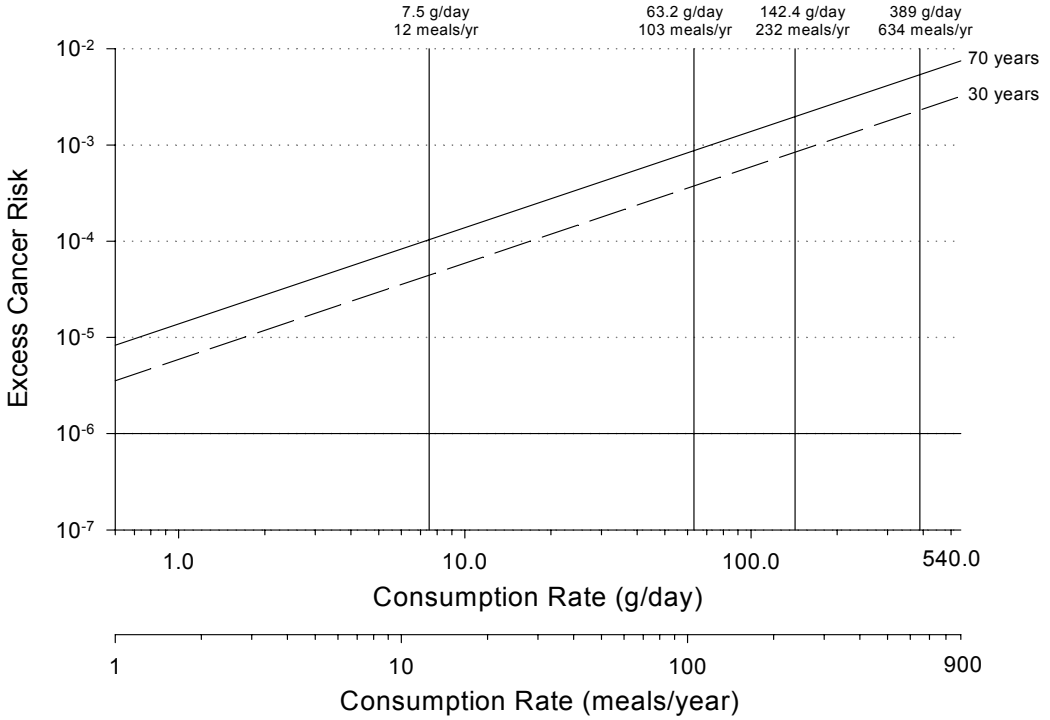
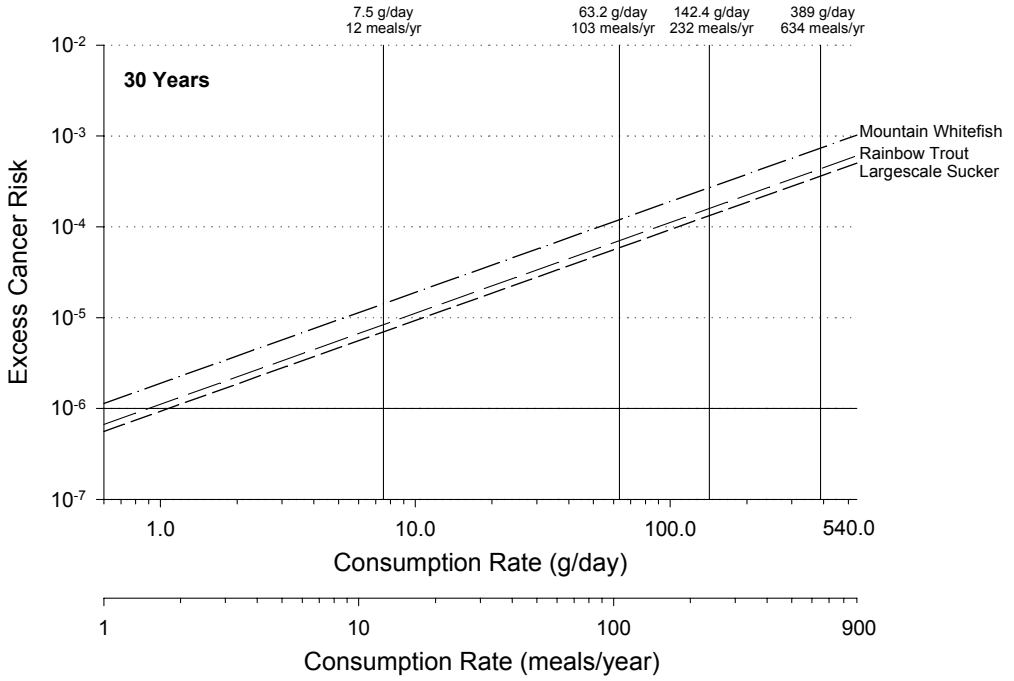


Figure 6-38. Excess cancer risk estimates for whole body samples of Pacific lamprey collected at Site 24, Fifteen Mile Creek



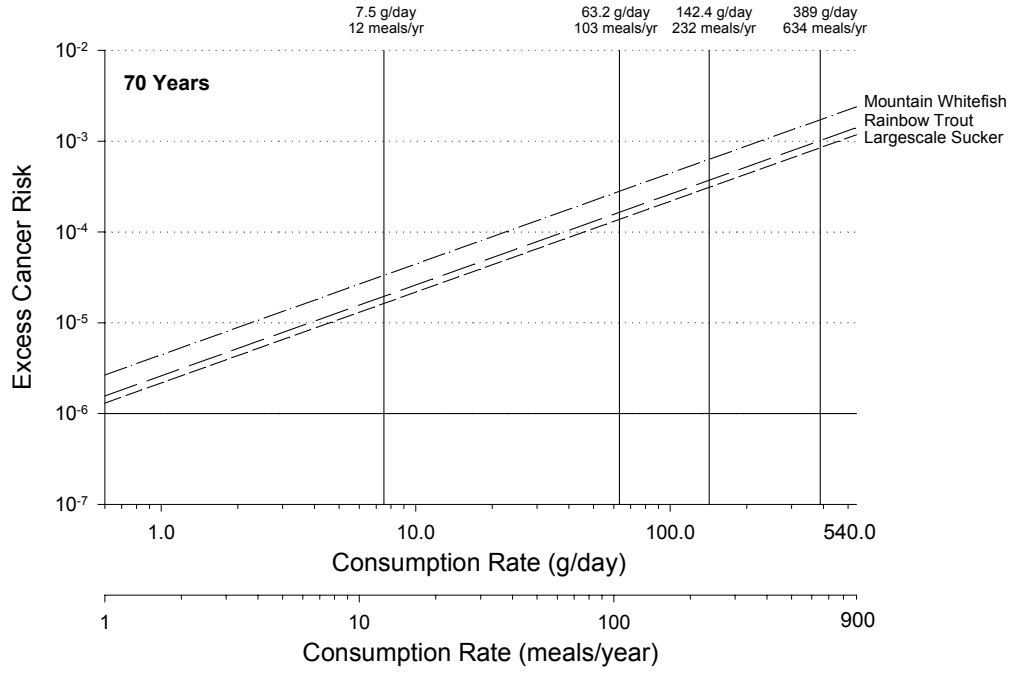


Figure 6-39. Excess cancer risk estimates for fillet samples of fish species collected at Site 98, Deschutes River

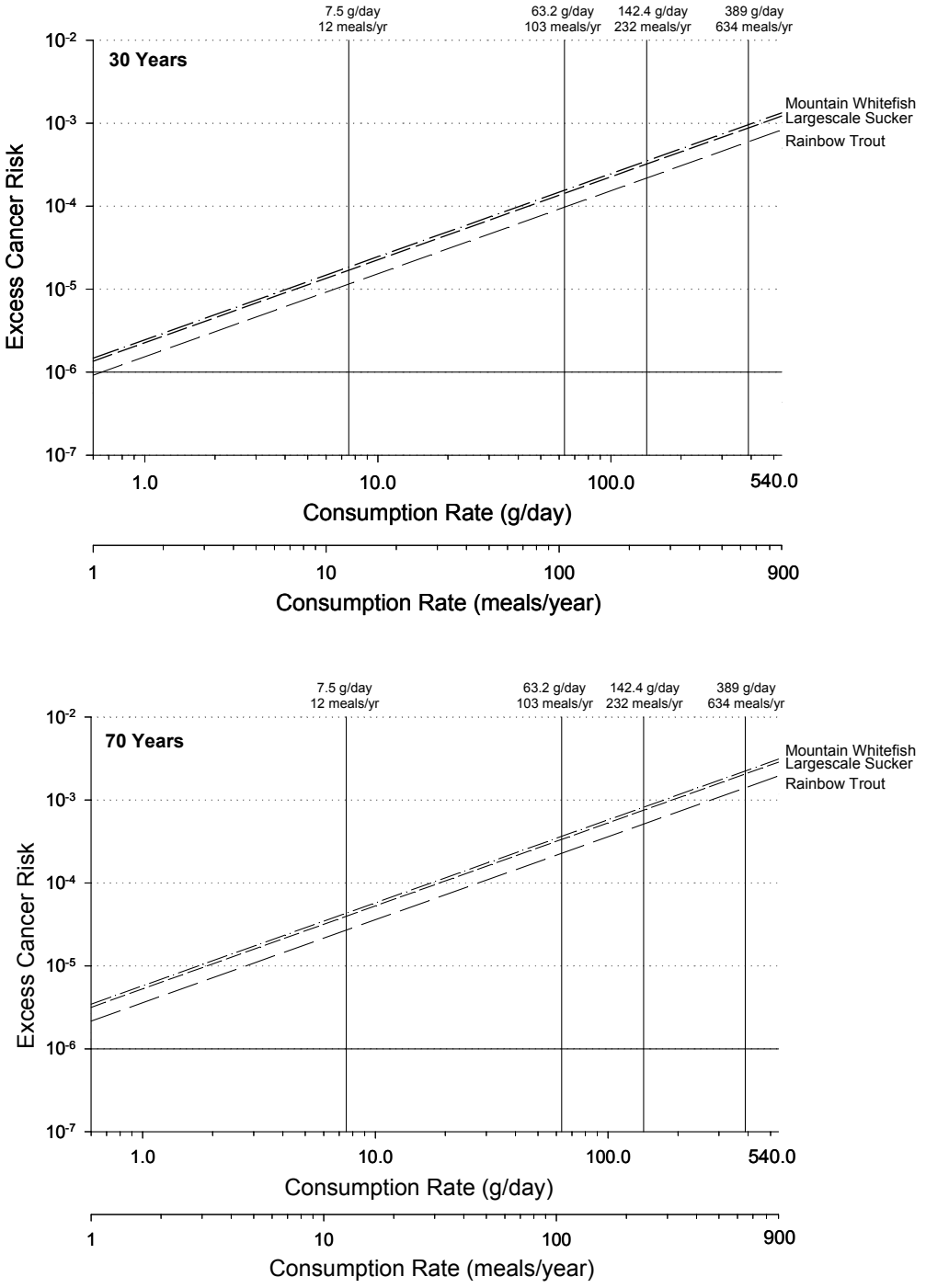


Figure 6-40. Excess cancer risk estimates for whole body samples of fish species collected at Site 98, Deschutes River

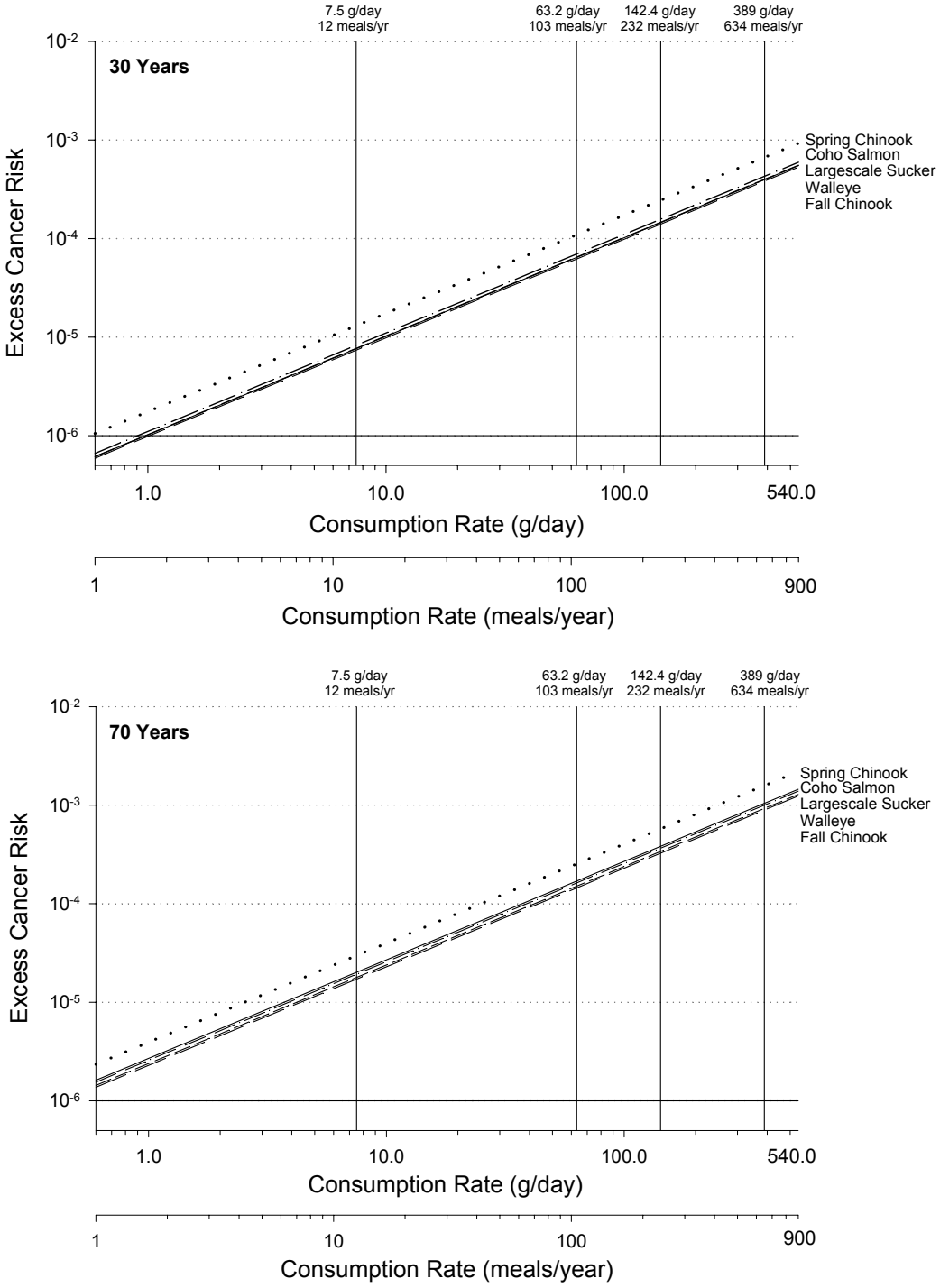


Figure 6-41. Excess cancer risk estimates for fillet samples of fish species collected at Site 30, Umatilla River

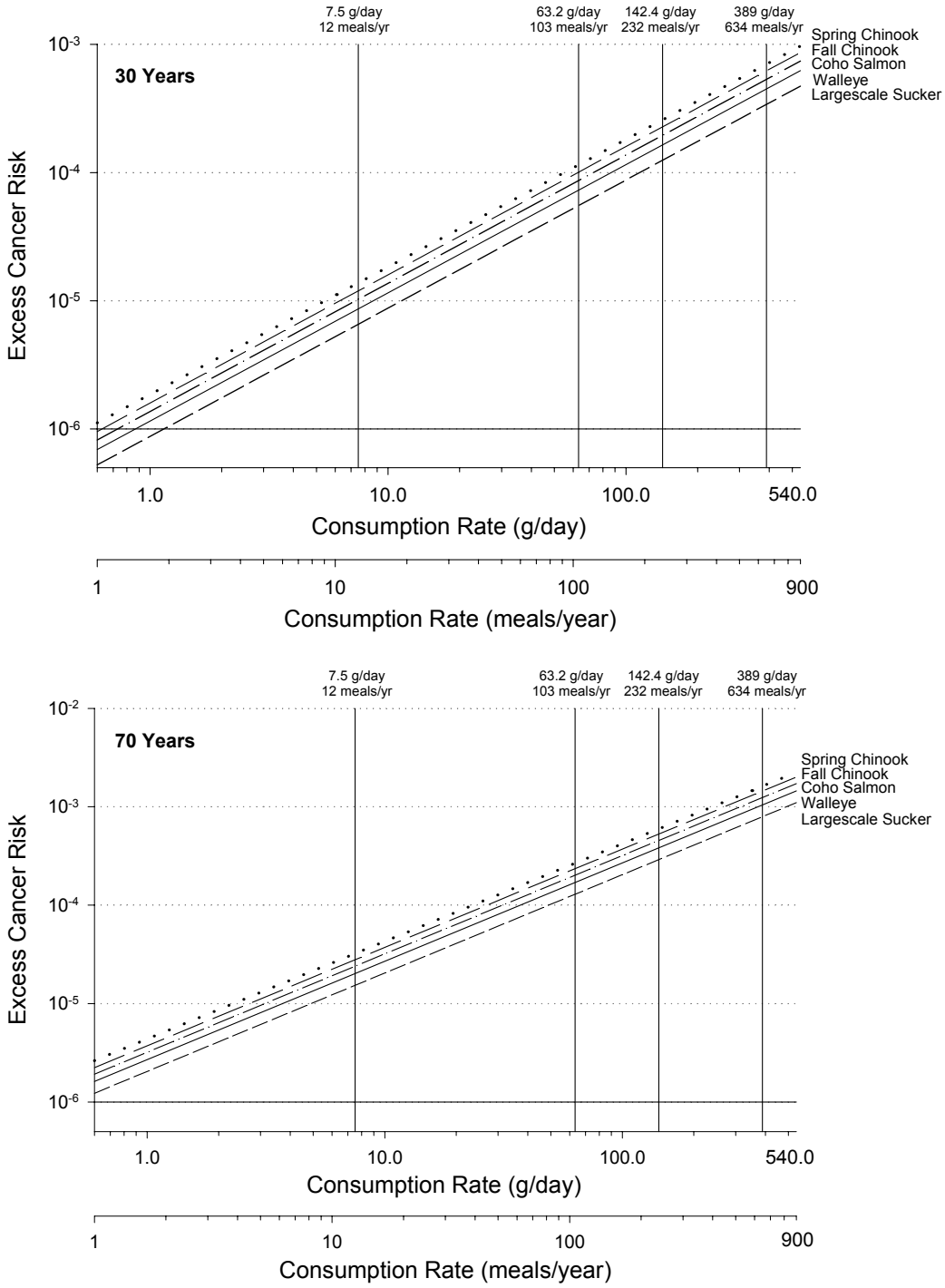


Figure 6-42. Excess cancer risk estimates for whole body samples of fish species collected at Site 30, Umatilla River

Fillet samples of one species were collected at Site 101, mountain whitefish. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration (Figure 6-43). Whole-body samples of two species were collected at this site, mountain whitefish and rainbow trout. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration. The highest cancer risk estimates in whole-body samples occurred for mountain whitefish followed by rainbow trout (Figure 6-44).

N.3.10 Grande Rhonde River

One sampling site was located in the Grande Rhonde River, site 94. One species was sampled at this site, spring chinook salmon. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except at the very lowest consumption rates with a 30-year exposure duration (Figure 6-45).

N.3.11 Snake River

Two sampling sites were located in the Snake River, 13 and 93. Fillet samples of two species were collected at site 13, largescale sucker and white sturgeon. Cancer risk estimates in fillet samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations. The highest cancer risk estimates occurred for white sturgeon followed by largescale sucker (Figure 6-46). Whole-body samples of one species, largescale sucker, were collected at site 13. Cancer risk estimates in whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration (Figure 6-47). One species was collected at Site 93, steelhead. Cancer risk estimates in fillet samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration. Cancer risk estimates in whole-body samples exceeded a cancer risk of $1x10^{-6}$ at 30- and 70-year exposure durations. Cancer risk estimates at site 93 were higher in fillet samples than in whole-body samples (Figure 6-48).

6.3.12 Clearwater River

One sampling site was located in the Clearwater River, site 96. One species was collected at this site, steelhead. Cancer risk estimates for fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations. Cancer risk estimates were higher in whole-body samples than fillet samples (Figure 6-49).

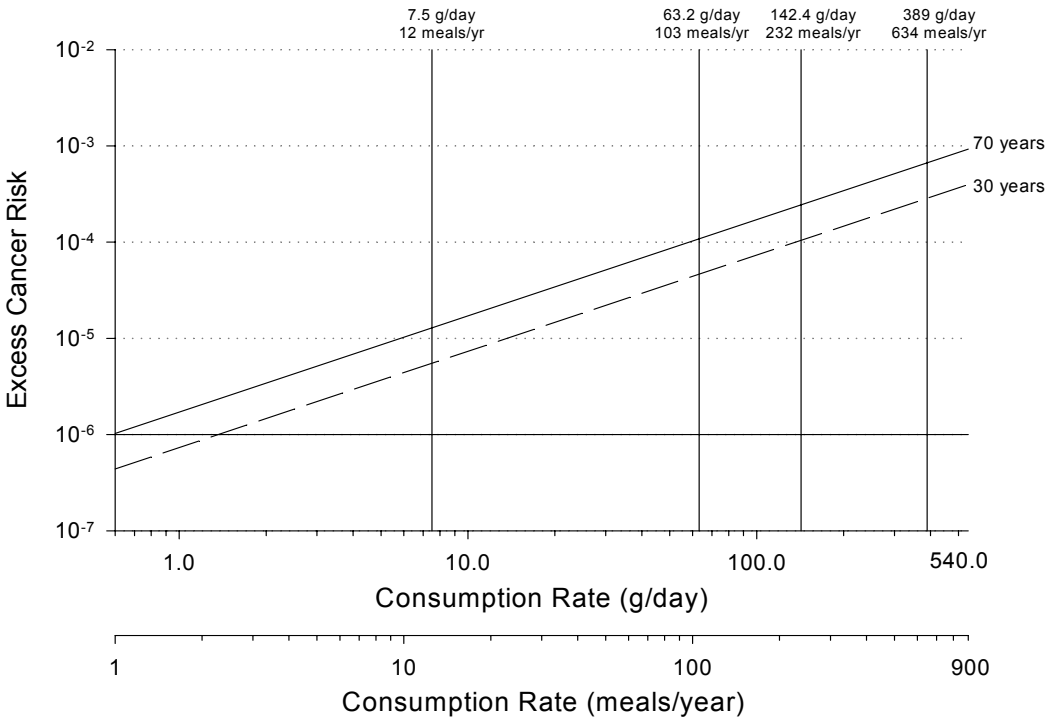
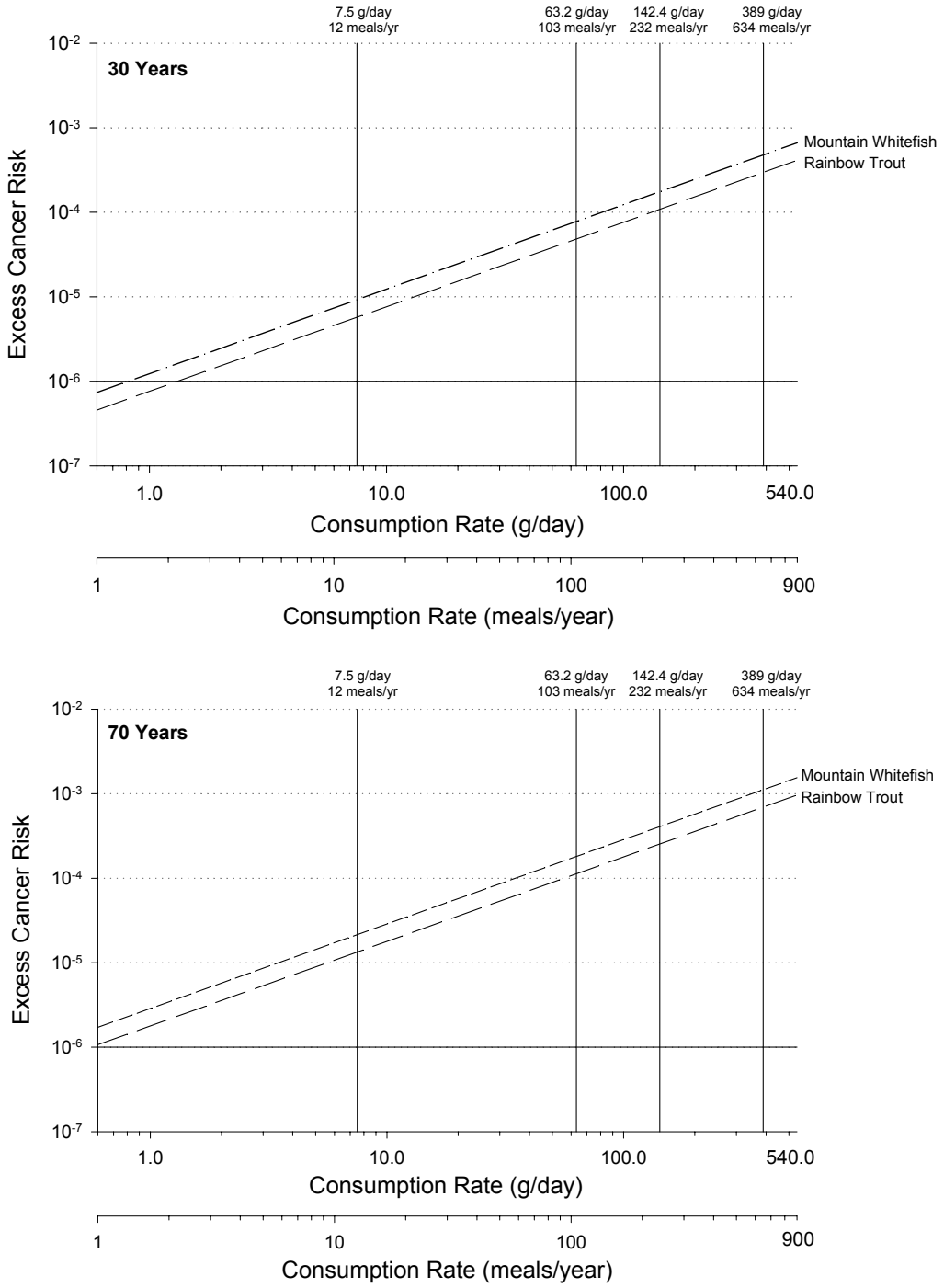
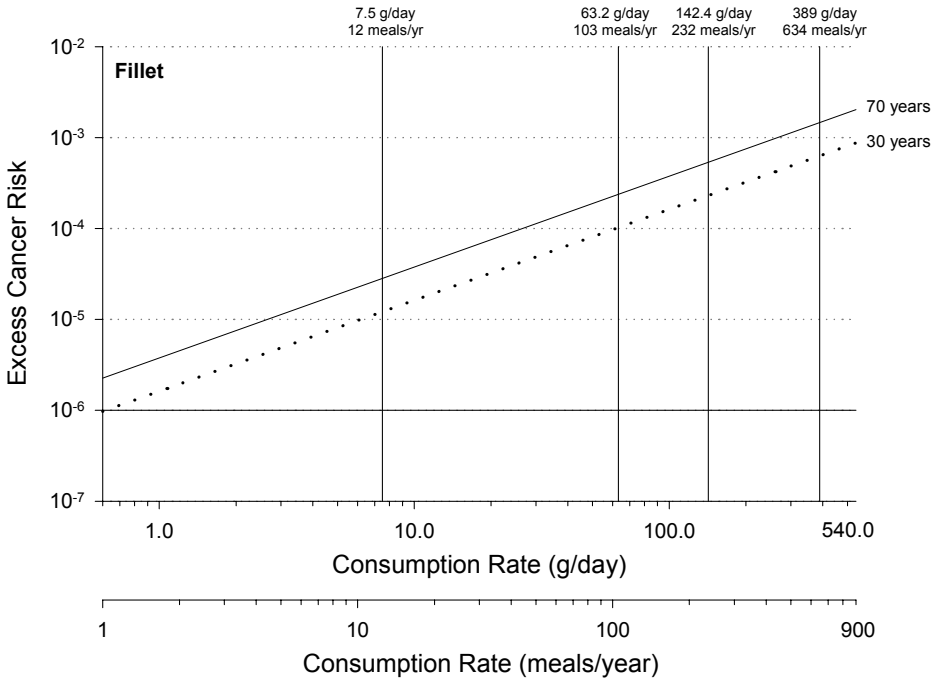


Figure 6-43. Excess cancer risk estimates for fillet samples of mountain whitefish collected at Site 101, Umatilla River



Fiugre 6-44. Excess cancer risk estimates for whole body samples of fish species collected at Site 101, Umatilla River



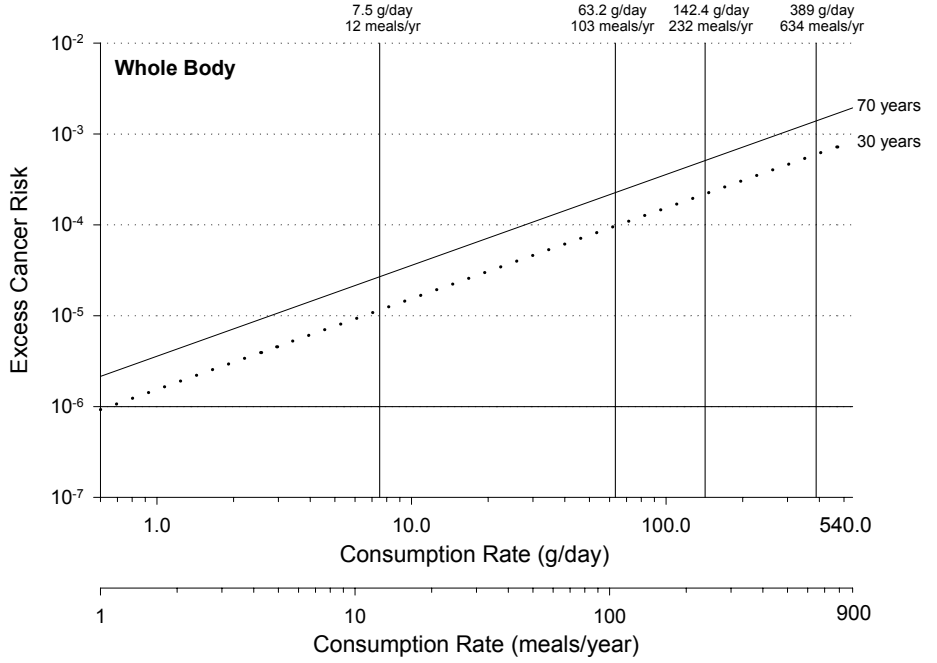


Figure 6-45. Excess cancer risk estimates for fillet and whole body samples of spring chinook collected at Site 94, Grande Rhonde River

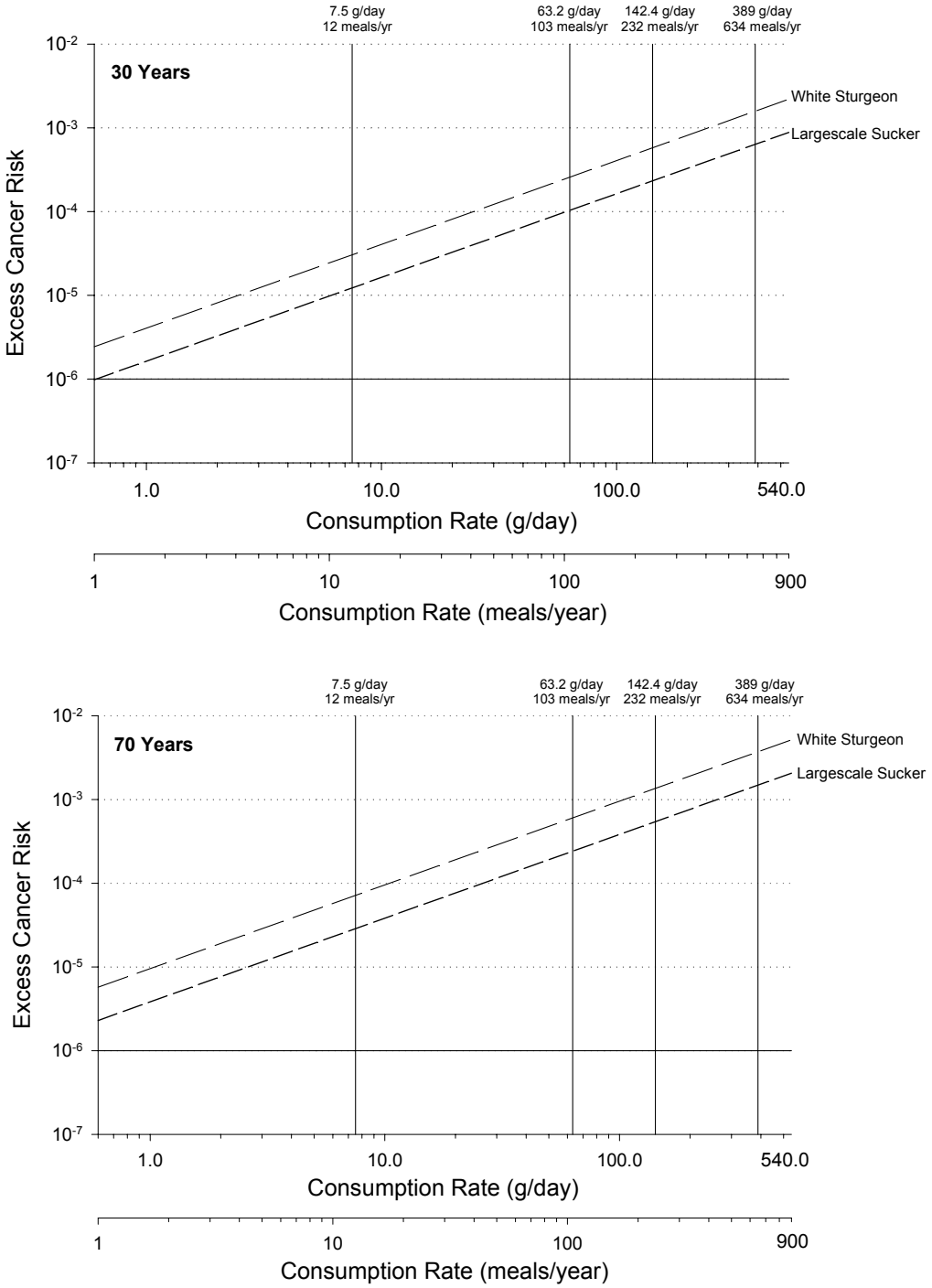


Figure 6-46. Excess cancer risk estimates for fillet samples of fish species collected at Site 13, Snake River

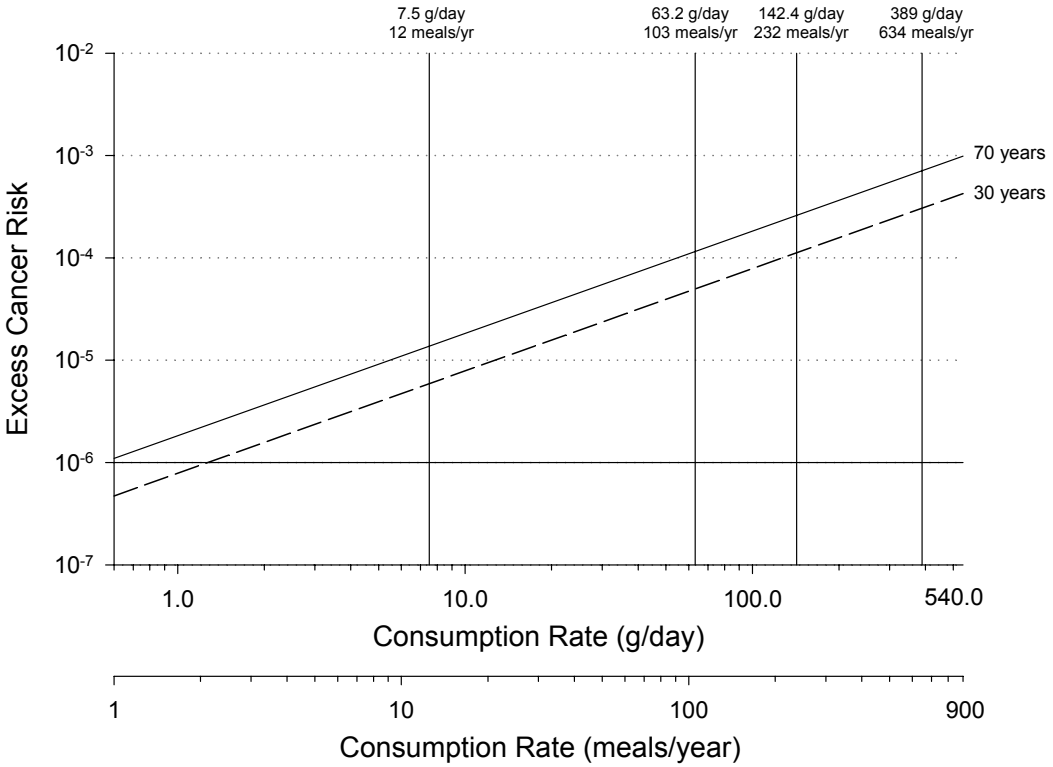
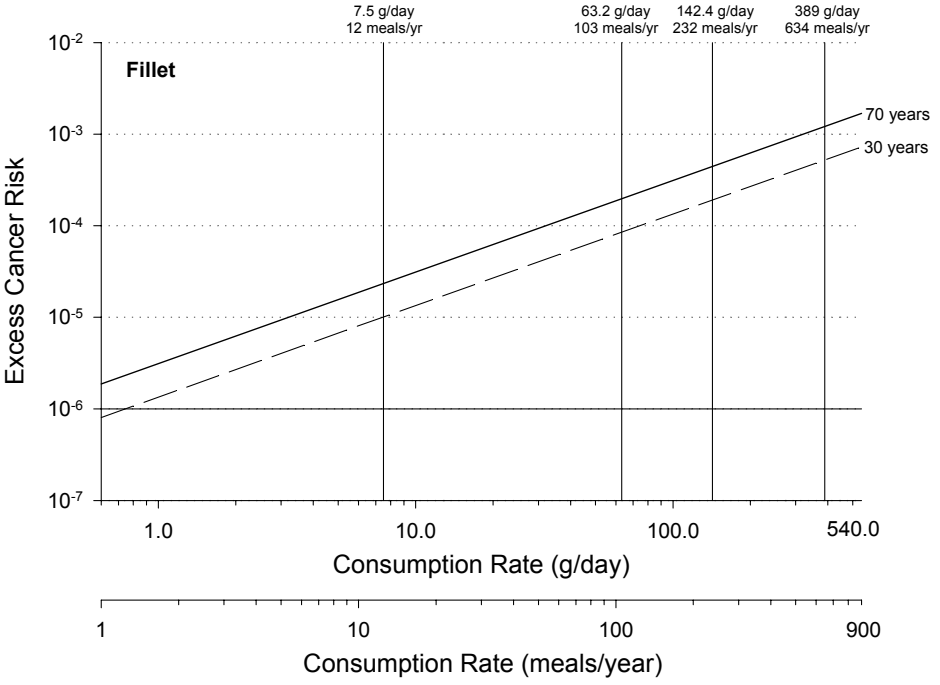


Figure 6-47. Excess cancer risk estimates for whole body samples of largescale sucker collected at Site 13, Snake River



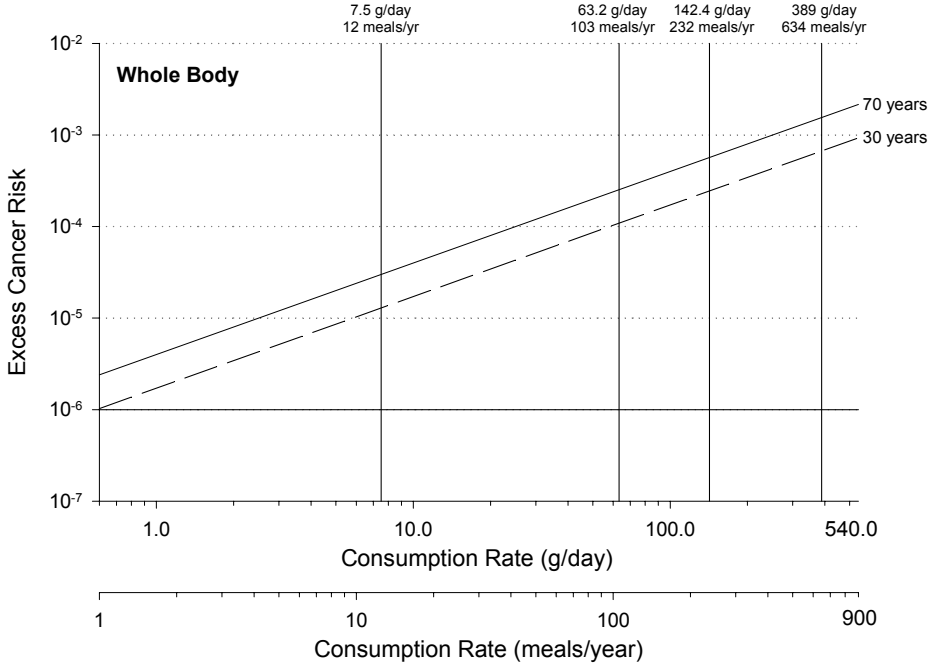


Figure 6-48. Excess cancer risk estimates for samples of steelhead collected at Site 93, Snake River

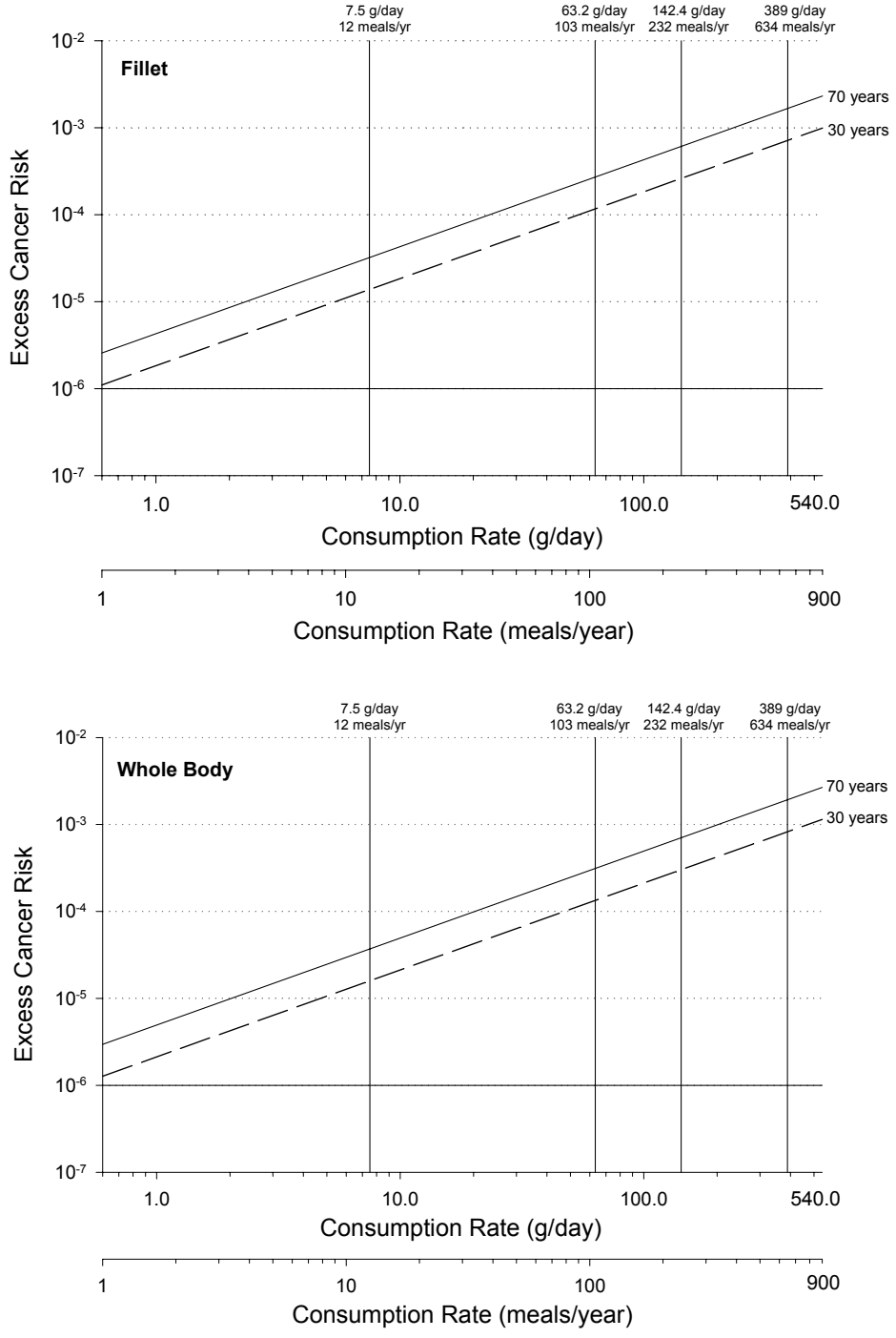


Figure 6-49. Excess cancer risk estimates for steelhead collected at Site 96, Clearwater River

6.3.13 Yakima River

Two sampling sites were located in the Yakima River, Site 48 and Site 49. Fillet samples of five species were collected at Site 48, fall chinook salmon, largescale sucker, mountain whitefish, spring chinook salmon, and steelhead. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration in spring chinook salmon, fall chinook salmon, and steelhead. The highest cancer risk estimates in fillet samples occurred for mountain whitefish followed, in decreasing order, by largescale sucker, spring chinook salmon, fall chinook salmon, and steelhead (Figure 6-50). Whole-body samples of six species were collected at Site 48, bridgelip sucker, fall chinook salmon, largescale sucker, mountain whitefish, spring chinook salmon, and steelhead. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration in fall chinook salmon and steelhead. The highest cancer risk estimates in whole-body samples occurred for mountain whitefish followed, in decreasing order, by largescale sucker, bridgelip sucker, spring chinook salmon, fall chinook salmon, and steelhead (Figure 6-51).

Two species were collected at Site 49, largescale sucker and rainbow trout. Cancer risk estimates in fillet and whole-body samples exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except for low consumption rates with a 30-year exposure duration in rainbow trout. The highest cancer risk estimates in fillet and whole-body samples occurred for largescale sucker followed by rainbow trout (Figures 6-52 and 6-53).

6.3.14 Wenatchee River

One sampling site was located in the Wenatchee River, site 51. One species was collected at this site, spring chinook salmon. Cancer risk estimates exceeded $1x10^{-6}$ at 30- and 70-year exposure durations, except at the lowest consumption rates with a 30-year exposure duration (Figure 6-54).

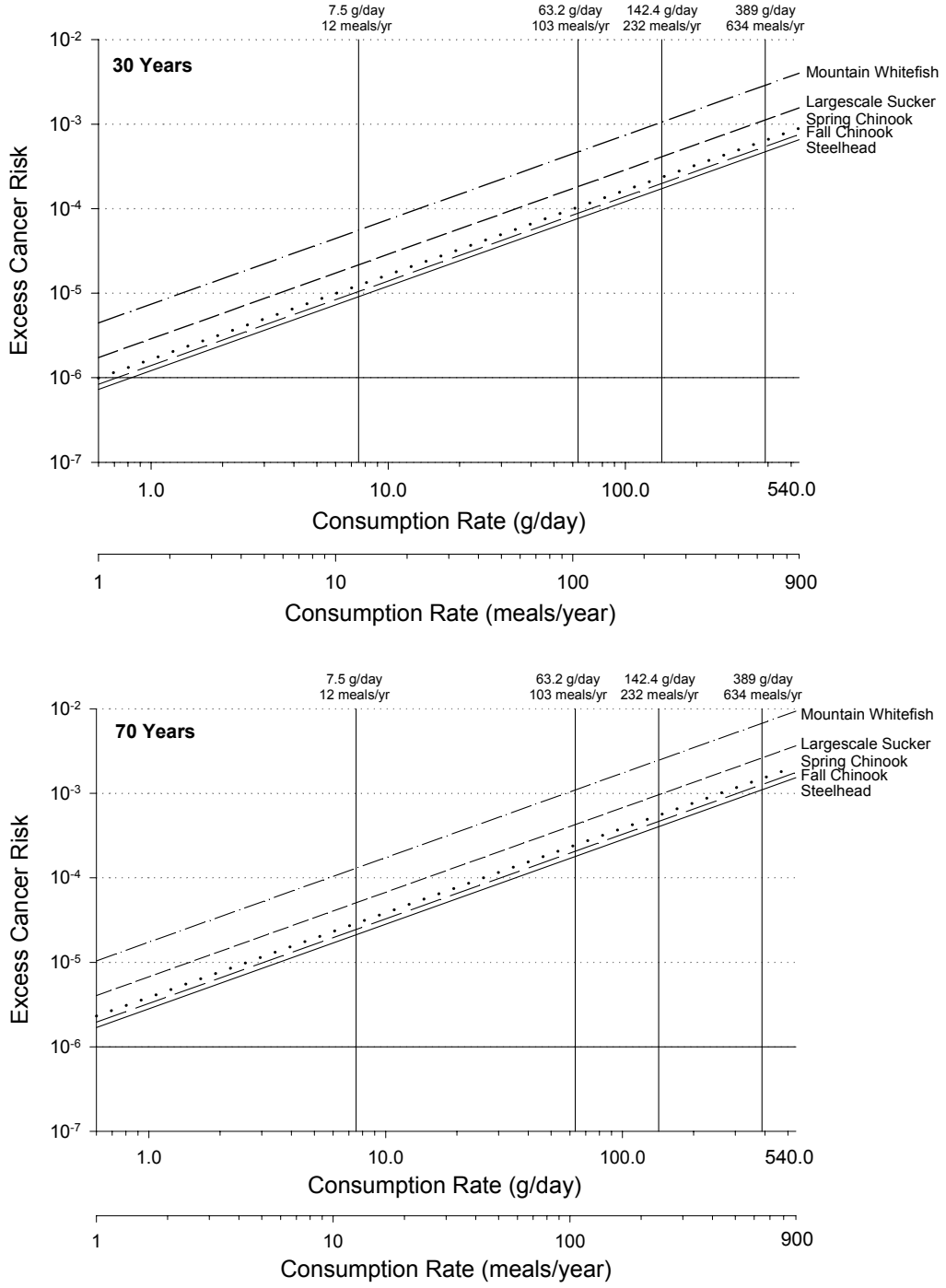


Figure 6-50. Excess cancer risk estimates for fillet samples of fish species collected at Site 48, Yakima River

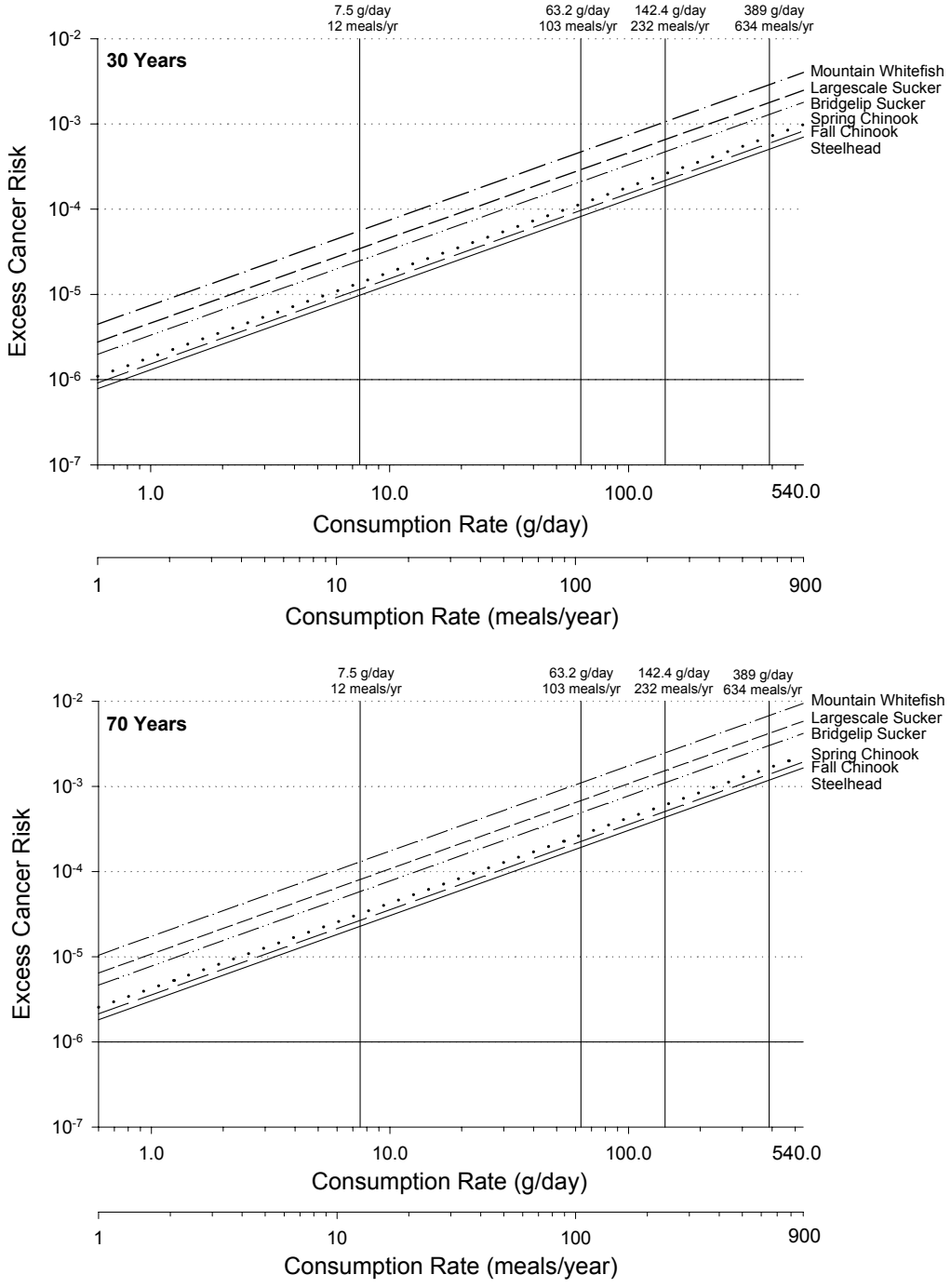


Figure 6-51. Excess cancer risk estimates for whole body samples of fish species collected at Site 48, Yakima River

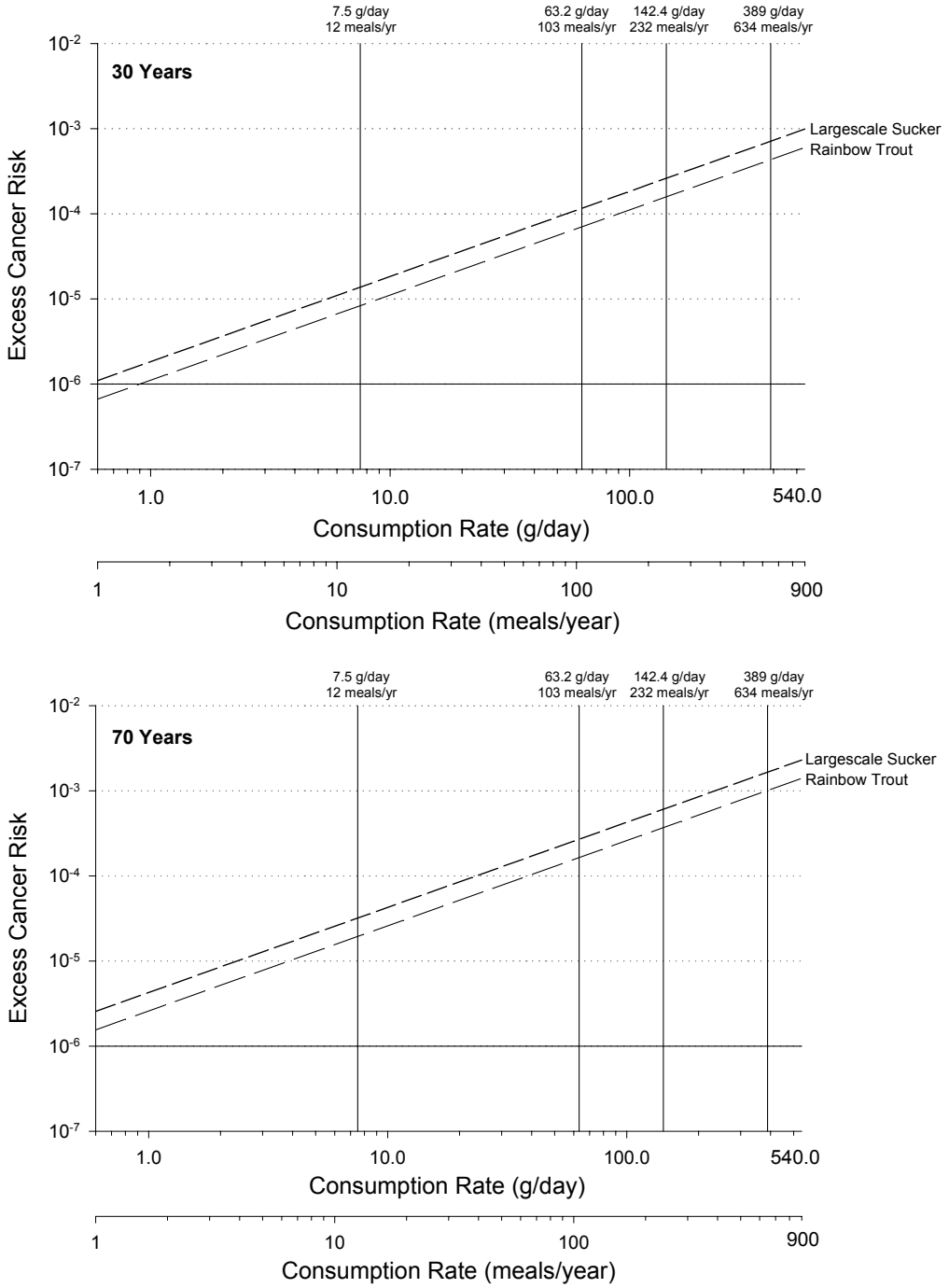


Figure 6-52. Excess cancer risk estimates for fillet samples of fish species collected at Site 49, Yakima River

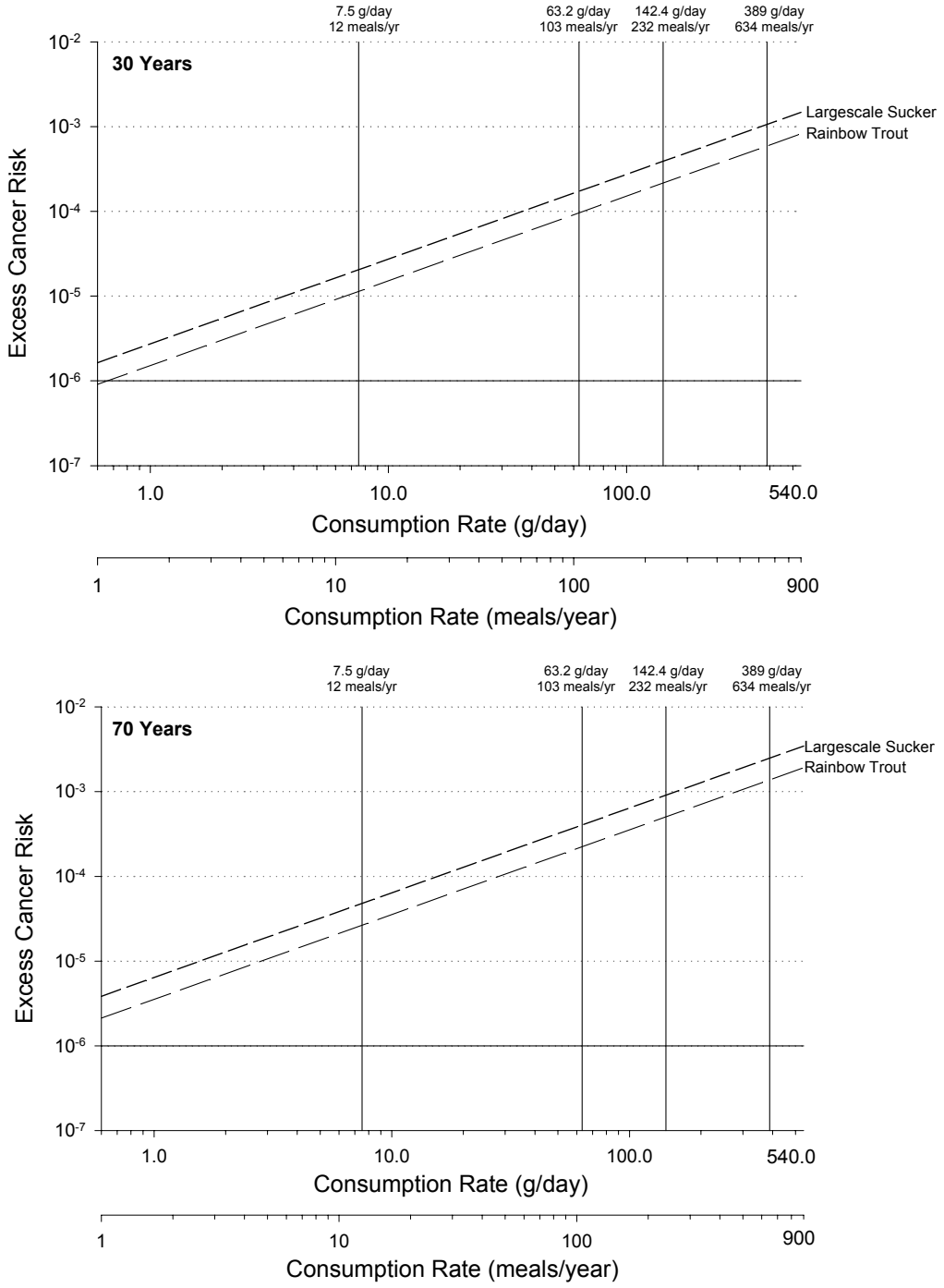


Figure 6-53. Excess cancer risk estimates for whole body samples of fish species collected at Site 49, Yakima River

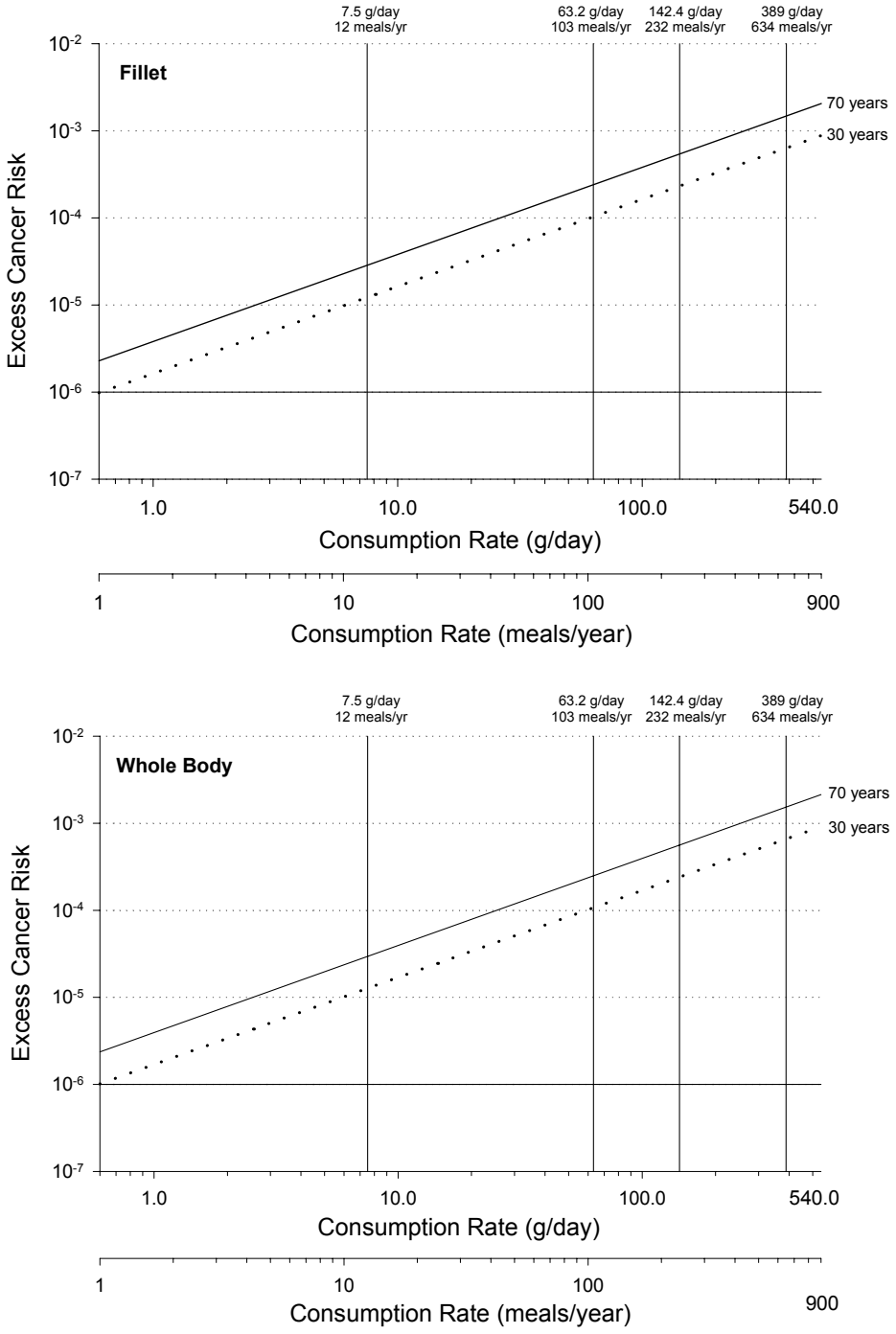


Figure 6-54. Excess cancer risk estimates for samples of spring chinook collected at Site 51, Wenatchee River